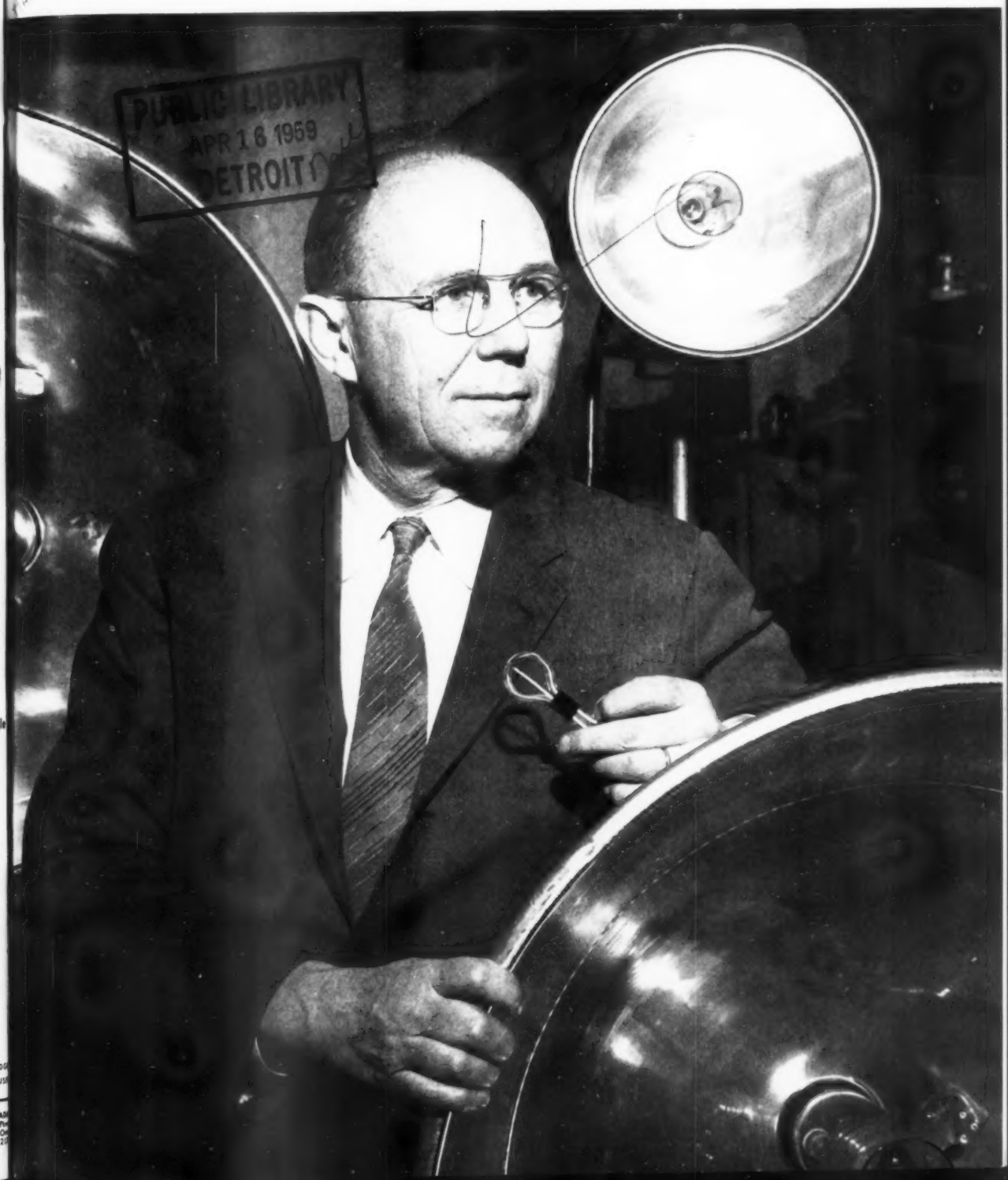
TECHNOLOGY REVIEW

April 1959



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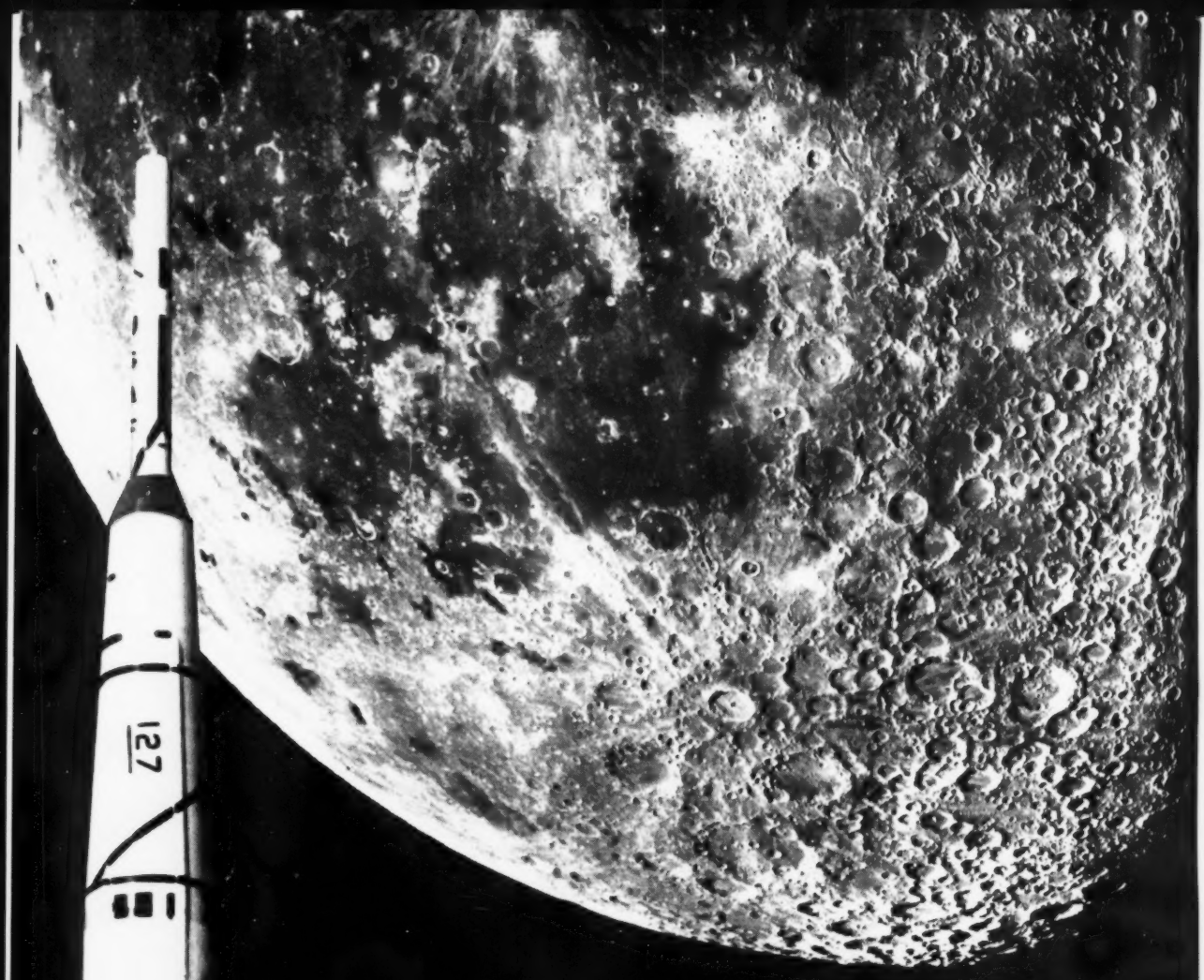

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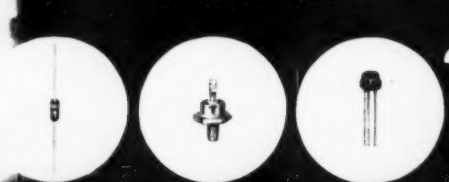

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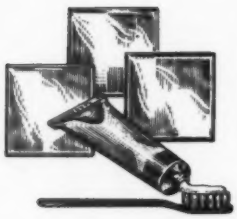

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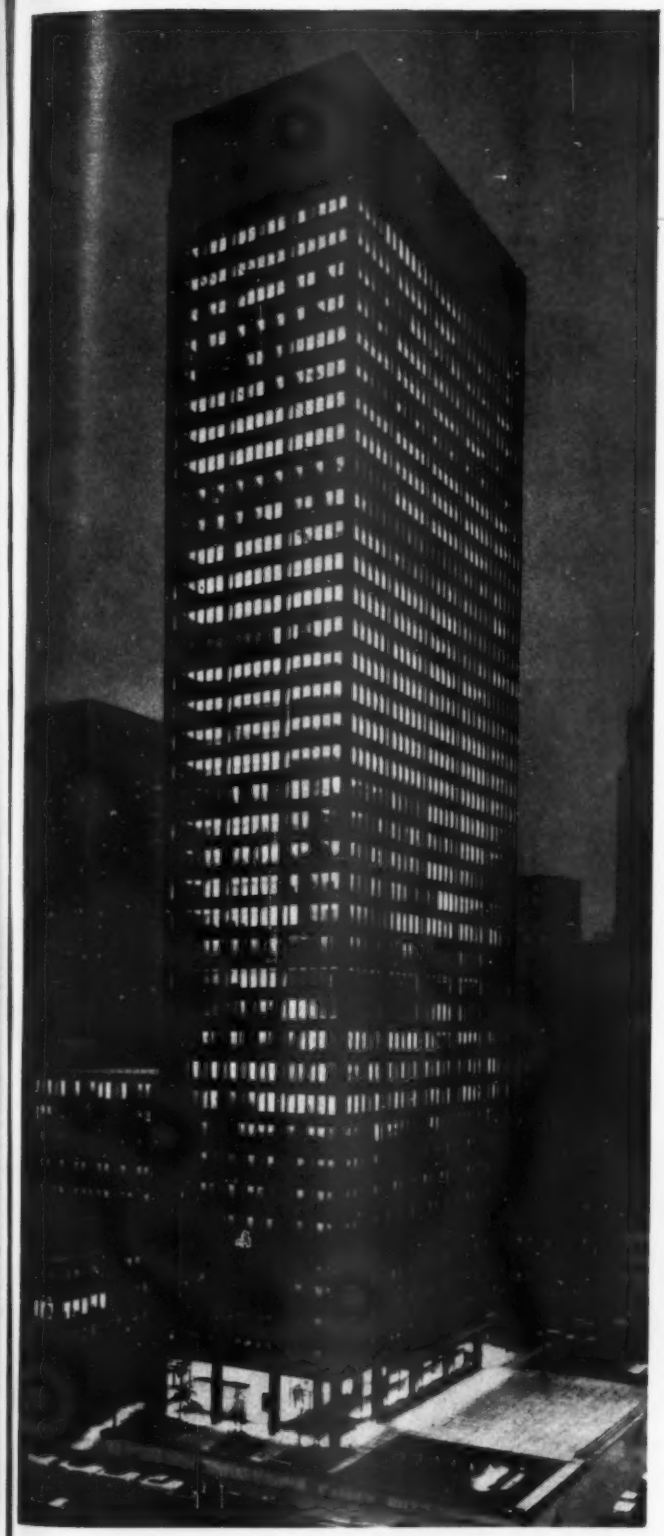


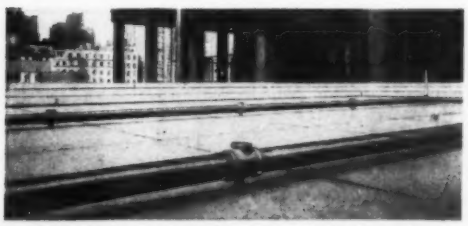
FROM THE GROUND UP . . .

World's First Bronze Skyscraper Uses Phelps Dodge Red Brass Pipe!

A vital network of Phelps Dodge Red Brass Pipe—roughly 17 miles of it—runs through the magnificent new bronze office building at 375 Park Avenue in New York. From street level to the top of this striking skyscraper, the maze of piping carries the hot and cold water needed for the 38-story structure's mammoth plumbing system.

A number of especially designed water fixtures, including a unique central drinking water system, are connected to these Phelps Dodge pipes. Other PD pipes under the park plaza supply water to the graceful fountains and pools in front of the building.

Plumbing contractors know that the famous Phelps Dodge "Mine-to-Market" quality line of copper tube and pipe more than meets every requirement for modern plumbing systems. That's why they specify Phelps Dodge for every kind of installation —from skyscrapers to homes!



Red brass pipe in pool bottoms on building plaza furnishes water for beautiful fountain displays.

Quality tube sold the quality way—through authorized wholesalers!

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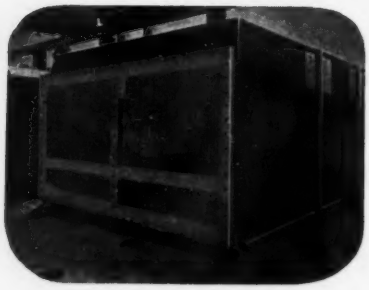
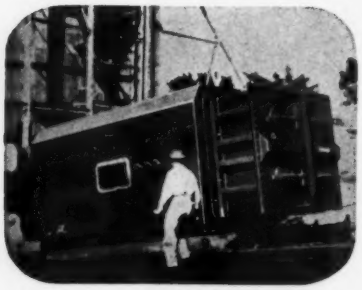
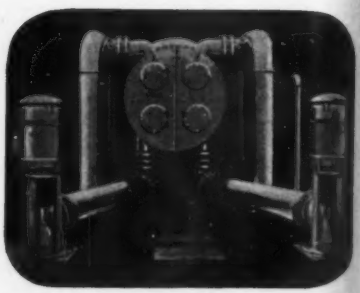
HOW C.H. WHEELER CONDENSER DESIGN saves space...



Head Room problems are solved by compact condensers like this one. Turbine floor to basement floor, in this case, is only 20 ft. The Unit has 65,000 square feet of condensing surface.

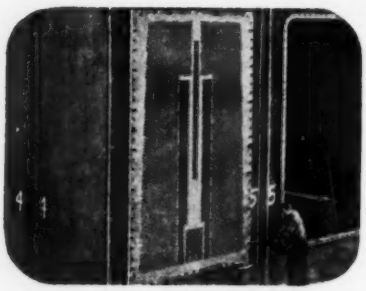


Rectangular Cross Section makes C.H. Wheeler Condensers adaptable to nearly any space or condenser arrangement because the length, width and height of any Wheeler Unit can be varied almost at will.

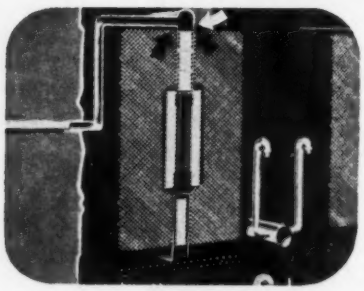


But Wheeler Doesn't limit itself to rectangular design. A round cross section worked out better here, for example, at the first planned gas-steam turbine station ever designed and built in United States.

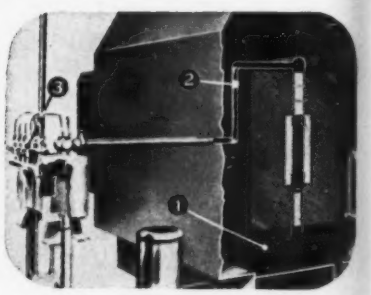
improves power generating efficiencies...



Triple Lane tube layout, another design feature, provides 3 pathways for steam travel, utilizes maximum cooling surface and produces higher condenser vacuums for power generating stations.

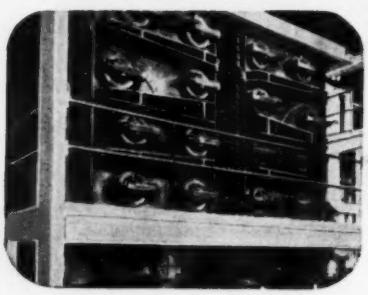


Location of air-vapor takeoff speeds steam travel and allows steam to penetrate to the peripheries of all tubes. It thus improves condenser efficiencies and overall power station operation as well.

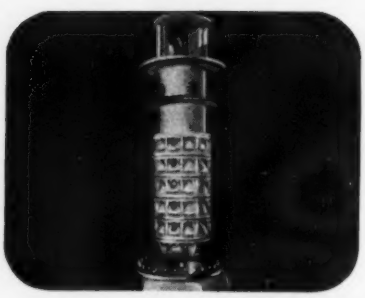


Deaeration of condensate not to exceed 0.01 cc. oxygen/liter is available with special Wheeler designs. Note the Deaerating Bars (1), the Air-Vapor Suction Line (2), and Tubejet® Ejectors (3).

and reduces maintenance



Patented Reverse Flow permits flushing tubes and sheets without shutting down Unit, during full load with either or both circulating pumps operating. No additional circulating water inlet or discharge piping necessary with C.H. Wheeler's Reverse Flow.



"Pull-Out" Condensate Pumps simplify maintenance because entire pumping element, including all rotating parts, can be removed without disturbing either the pump barrel or the piping connections.

C. H. Wheeler Circulating Pumps, like Condensate Pumps, are easy to inspect and maintain because of "Pull-Out" design. In addition, shafts are heat treated alloy steel and impellers are statically and dynamically balanced for trouble-free operation.

C. H. Wheeler has been designing and building condensers since 1903; has developed such features as Dual Bank Design and Reverse Flow.

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The ship has an unusual past. The entire after section was originally that of a T-2 tanker which broke in two in a storm. The machinery section was salvaged and towed to Anchorage, Alaska, where it provided electric power to the city for some years. Now, provided with entirely new bow and cargo sections, this extraordinary ship is back at sea. And the same C-E boilers that powered her, first as a World War II tanker and then as a floating power station, are doing the same reliable job for the S.S. Angelo Petri.

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25 YEARS AGO

A column of items of interest culled from The Technology Review's files

■ From data compiled by Registrar Joseph C. MacKinnon, '13, showing the mid-year academic accomplishment of the 485 freshmen of the Class of 1937, it appeared that some 200, who had been admitted "without examination from the upper scholastic fifth of their classes in accredited secondary schools," had scored an average rating of 3.40 contrasted with an average rating of 2.77 by those who had entered "by examination." Encouraged by the success of this "upper fifth" method, which had been started experimentally for the Class of 1936, the Faculty Committee on Admissions announced "still another alternative form of admission, College Board Plan B," which would be effective in the following autumn for the entering Class of 1938.

Plan B, the description read, "instead of requiring many examinations, . . . allows a high-ranking and well-recommended student from a secondary school to present subjects of his first three years on certificate, but tests the quality of his preparation by requiring College Board comprehensive examinations in four of his senior subjects. The Institute will require examinations in English, a modern language, advanced mathematics, and physics or chemistry. It will retain the old College Board Plan A, . . . as well as the upper fifth plan and the New York State Regents plan."

■ Faculty promotions announced during April, 1934, included the following:

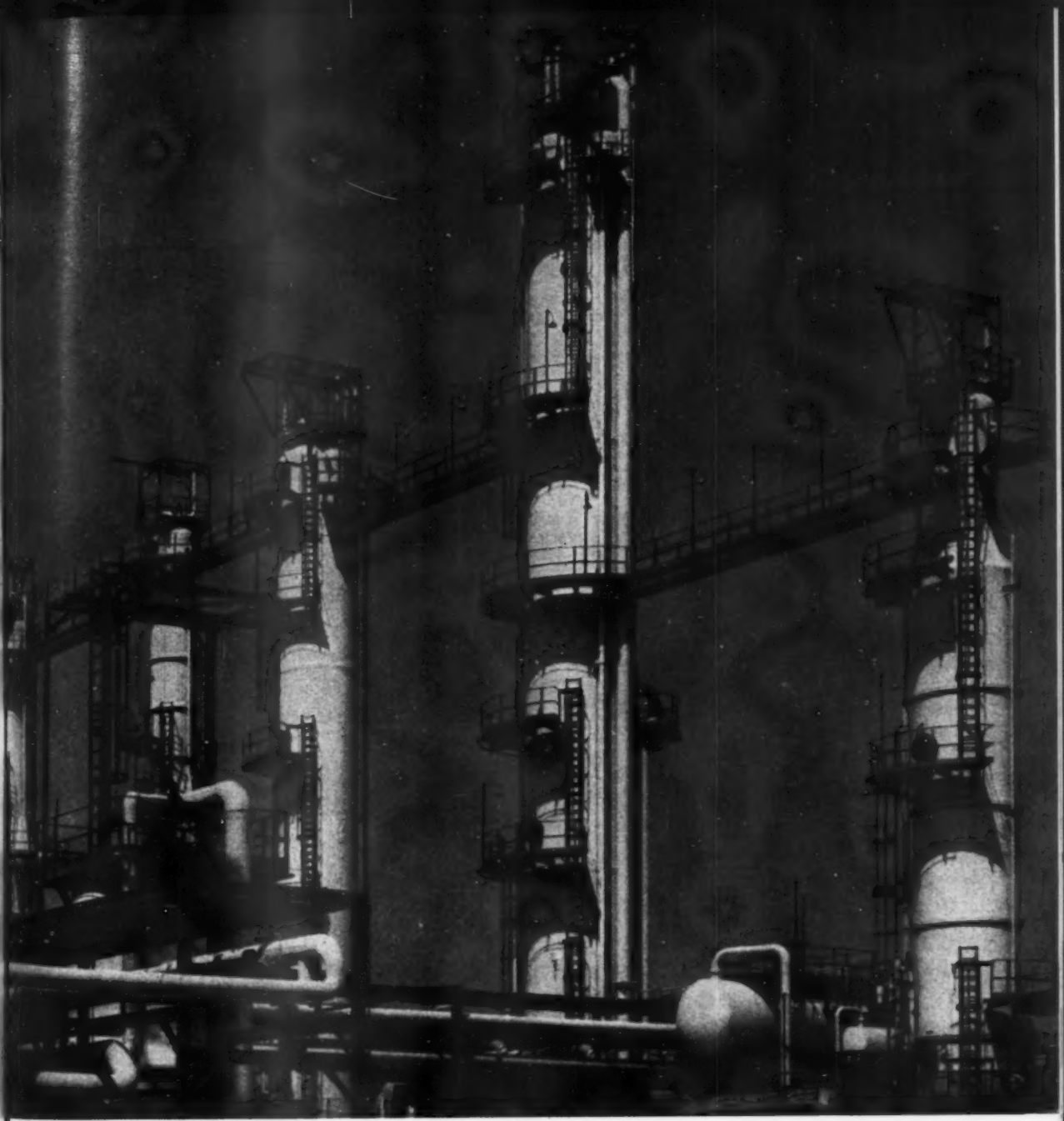
Professors *Charles B. Breed*, '97, as Head of the Department of Civil and Sanitary Engineering; *Ralph E. Freeman*, as Head of the Department of Economics and Social Sciences; and *Henry B. Phillips* as Acting Head of the Department of Mathematics.

To full Professorships: *Arthur C. Hardy*, '18, Physics; and *Walter C. Schumb*, Chemistry.

To Associate Professorships: *Raymond D. Douglass*, '24, Mathematics; *Philip M. Morse* and *Bertram E. Warren*, '24, Physics; *Edward R. Schwarz*, '23, Mechanical Engineering; and *Thomas K. Sherwood*, '24, Chemical Engineering.

To Assistant Professorships: *William P. Allis*, '23, and *John C. G. Wulff*, Physics; *Avery A. Ashdown*, '24, and *Stephen G. Simpson*, '16, Chemistry; *Herbert L. Beckwith*, '26, Architecture; *Frederick G. Fassett, Jr.*, English and History; *Samuel H. Caldwell*, '25, Electrical Engineering; and *John B. Wilbur*, '26, Civil and Sanitary Engineering.

■ . . . Elections to its membership at the April, 1934, meeting of the National Academy of Sciences included three members of the Institute's Faculty, namely: *Vannevar Bush*, '16, Vice-president and Dean of Engineering; *James F. Norris*, Director of the Research Laboratory of Organic Chemistry; and *Norbert Wiener* of the Department of Mathematics.



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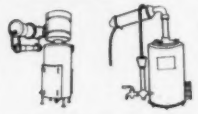

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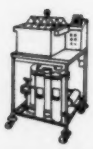

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MAIL RETURNS

The Russian View of M.I.T.

FROM JAMES CRITCHLOW, '45:

I happened this morning to be looking through the pages of a monthly magazine published by the Ukrainian Komsomol in Kiev (U.S.S.R.). To my surprise, one of the articles proved to be devoted almost entirely to the Institute. The author of the article, one of the group of Soviet student editors who visited the United States in May, 1958, "describes" M.I.T. and his impressions of it. Here are a few of his points:

1. M.I.T., a private institute, has 15,000 students. It is a kind of "corporation of education." To explain this, the author writes that "some corporations produce steel, copper, or electricity, but the Institute produces specialists with higher education."

2. The Institute is financed by "funds received from students in the form of tuition, by 'patronage' contributions from various 'national funds,' and also – in case of necessity – by issuance and sale of lotteries, shares, and so on."

3. The Institute has a newspaper called *The Tech* which "is possibly supported entirely by advertising, for the newspaper devotes no less than half of its pages to publication of advertisements." The writer adds that "the majority of this advertising has nothing in common with student needs." Like the big newspapers, *The Tech*, he explains, "seeks sensations," which Americans love.

4. The Institute's dormitories are built through contributions from various patrons and fraternities.

5. "We tried to dispel the atmosphere of mistrust and apathy which for years the bourgeois press has been instilling in the American student." Nevertheless, the author reports that his group were subjected to various "provocations" during their visit to Tech.

These are just a few of the interesting "facts" about "Massachusets 'kyy institut tekhnologii" presented in the article's six pages of fine print.

My work here as manager of Radio Liberation's Central Research Department makes me a constant reader of Soviet publications.

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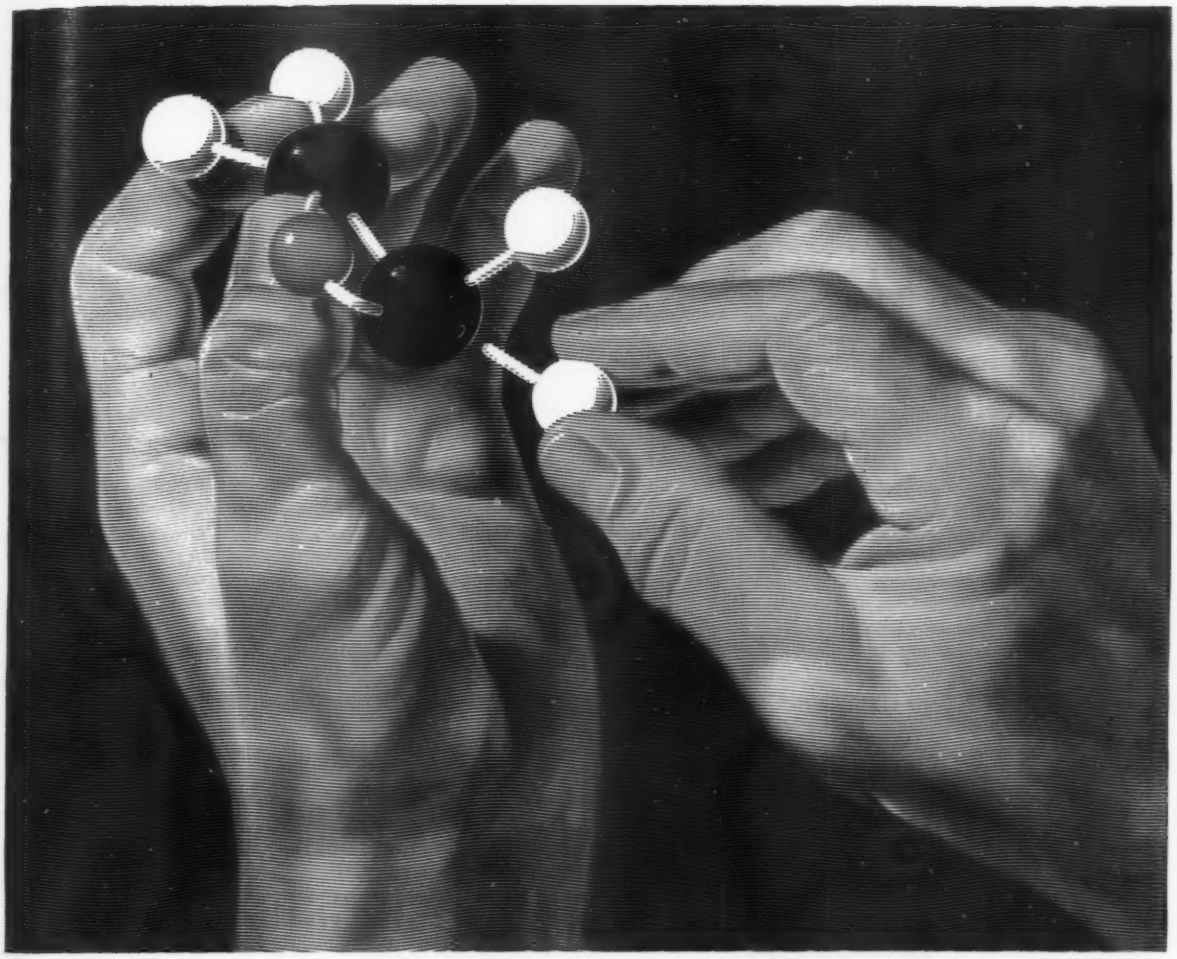

Molecular model of ethylene oxide—one of the basic building blocks in Union Carbide's chemistry.

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Ever wonder what's behind the steady stream of new and better products we enjoy today? The answer is research by men and women with driving curiosity and bold imagination.

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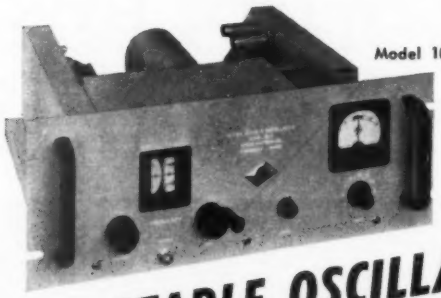

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Now...with new rubbers, new chemicals, new cords...Goodyear brings you:

The World's First Turnpike-Proved Tires!

Harbor Freeway. Photo taken at Wilshire Blvd. overpass in Los Angeles.

Many a tire that's been "getting by" around town will fail the test of the tire-eating turnpikes. New Turnpike-Proved Tires by Goodyear give up to 25% more safe mileage—no matter where you drive!

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This year you'll be driving more than ever before on throughways, expressways and turnpikes—at high legal speeds. For greater safety, you need Turnpike-Proved Tires by Goodyear.

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The Technology Review

REG. U.S. PAT. OFF.

EDITED AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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Events such as you see below have changed the air of undergraduate life at M.I.T., Dean John T. Rule, '21, recently told the Alumni Council (see page 322). This is Bobby Clotworthy, 1956 Olympic champion, clowning during an All-Institute Swimming Meet in the Alumni Pool.

Photo by David A. Cahlander, '59

EDITOR: Volta Torrey; BUSINESS MANAGER: R. T. Jope; CIRCULATION MANAGER: D. P. Severance; EDITORIAL ASSOCIATES: Paul Cohen, F. W. Nordsiek, J. J. Rowlands; EDITORIAL STAFF: Ruth King, Winifred R. Sibley; BUSINESS STAFF: Madeline R. McCormick; PUBLISHER: H. E. Lobdell.

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Three weeks must be allowed to effect change of address, for which both old and new addresses should be given.

President Stratton Honors a Distinguished Undergraduate Swimmer

Miss Mary Elizabeth Schumacker, '60, holder of regional swimming records and an Olympic hopeful, received a "Pat on the Back" award last month from Sports Illustrated. *President Stratton presented the trophy to her at the New England Intercollegiate Swimming Meet on March 7 at the Alumni Pool. "Betsy" is a mathematics student from Devon, Pa.*

"I wish she could compete for M.I.T.," says Coach Charley Batterman. "She can swim the 440 faster than anybody in school." She practices daily, and judges diving at men's intercollegiate meets. "I feel very much at home here," says Miss Schumacker. "The important thing is I'm getting the math training to teach and the swimming training to coach."

The Technology Review

VOL. 61, NO. 6 APRIL, 1959

The Trend of Affairs

Radar Signals Travel From M.I.T. to Venus and Back

■ A radar finger reached out more than 28,000,000 miles last year from M.I.T. Lincoln Laboratory's Millstone Hill antenna and touched Venus twice.

Darting at light's speed, a train of pulses sent from earth returned to earth about five minutes later. Making certain, however, that what came back was indisputably an echo of what was transmitted has taken months. Could nature's quirks and noises have deceived the experimenters? There is less than one chance in 10,000,000 that they did.

Venus and the earth were receding from each other. A signal sent at 2:21 P.M. Eastern Standard Time, February 10, 1958, returned 295.5065 (plus or minus .0005) seconds later. One sent at noon on February 12 returned 302.9842 seconds later, indicating that the two planets then were 696,640 miles farther apart than they had been two days earlier.

Venus was 100 times as far as radar had reached previously. The findings suggested that the astronautical unit (the mean radius of the earth's orbit around the sun) may be 1,200 miles less than the value that is given for it in the *Nautical Almanac* for 1958. Future radar work may enable the astronomers to determine the distances to various parts of the solar system more precisely.

The next close approach of Venus and the earth will be in September. The curtain of clouds that hides this neighbor's surface from optical telescopes may be penetrated again then by radar.

The pioneers, in actually touching another planet, credit their success to the development of a solid-state "maser" amplifier (which introduces very little noise), a high-power transmitter with a steerable antenna (their antenna is 84 feet in diameter), and sophisticated new methods of detecting weak signals (they used a large high-speed digital computer).

The transmitter was operated for about 4.5 minutes on each occasion, then shut off. A recording of what was received in the next five minutes was prepared in such a way that it could be searched for the transmitted signal by the computer. The pattern of the signal sent out consisted of about 8,000 points, and about 600 lengthy calculations were carried out to derive the curves that gave the results.

One of the Millstone Hill radar's klystron transmitter tubes.

The research team was led by Robert Price, '53, and Paul E. Green, Jr., '53, and included Thomas J. Goblick, Jr., '58, Robert H. Kingston, Jr., '47, Leon G. Kraft, Jr., '49, Gordon H. Pettengill, '48, Roland Silver, and William Boyd Smith, '55.

The radar that they used was developed for the U.S. Air Force, just in time to track the first Sputnik. It was operated in the lower part of the ultra-high-frequency band, in the vicinity of 300-500 megacycles per second, with a pulse power of 265 kilowatts. The position and path of Venus were calculated from published astronomical data. The antenna then was adjusted to point the beam at the planet and follow it across the sky.

When emitted, the signals were 10,000,000 or more times as strong as when received. The returns were

so weak that individual pulses could not be detected or measured in the usual ways. Since it was foreseen that they would be buried in extraneous noise picked up from the sky, extraordinary pains were taken to reduce the noise generated within the system.

The solid-state maser, which kept the system's noise low, is a new kind of amplifier which Lincoln Laboratory has helped to introduce. It since has been used elsewhere to extend the range of radio telescopes, but this was the first recorded use of it in either radio or radar astronomy, and the only reported use of a maser in the ultra-high-frequency range. The greater sensitivity attained with it was the equivalent of a fourfold increase in transmitter power.

To facilitate finding the signal in the returns and measuring the time required for the round trip, the pulses that were sent out were coded. The transmitted signal was a train of short pulses spaced at intervals of time which were varied in a controlled manner. A special time-sequence pattern thus was created which could be used by the computer when it examined the returns. Each run yielded a train of several thousand returned pulses, individually too weak to be detected, but collectively identifiable by means of the pattern.

Although distances between planets have been determined with great accuracy in terms of astronomical units, they are not known with great precision in miles or meters. More observations will be necessary to ascertain these distances with the precision that men now desire for ventures into space. These first observations have indicated radar's potentialities—and also have yielded provocative hints about the surface of Venus. It cannot be observed with telescopes because of the planet's thick atmosphere. Radar returns, it is hoped, will tell us something in the future about the surface and the rate at which Venus rotates.

To appreciate what has been done, it is helpful to think of the earth and Venus as two ping-pong balls 100 yards apart. On this scale, the moon might be represented by a peanut, one yard from one of the balls. Radio signals were bounced off the moon in 1946. The distance to Venus was 100 times as great. It was spanned, moreover, with an instrument that can make very accurate measurements.

Indicative of the reaction to the news was this telegram: MARCH 19, 1959, 8:31 A. M.
Dr. CARL F. J. OVERHAGE, DIRECTOR
LINCOLN LABORATORY, LEXINGTON, MASS.

DR. KILLIAN HAS INFORMED ME OF THE CONFIRMATION OF YOUR CONTACT BY RADAR WITH THE PLANET VENUS. CONGRATULATIONS TO ALL INVOLVED FOR THIS NOTABLE ACHIEVEMENT IN OUR PEACEFUL VENTURES INTO OUTER SPACE.

DWIGHT D. EISENHOWER

New Center for Urban Studies

■ Nathan M. Pusey, President of Harvard, and Julius A. Stratton, '23, President of M.I.T., announced in March that their schools had established a Joint Center for Urban Studies to search for basic facts in the tangled problems of the growth of big cities.

"Our aim is to establish an international center for advanced research, for documentation, and for stimulating inter-university efforts and collaboration in the urban field," said President Stratton.

"We are convinced that by combining our resources we can make outstanding contributions in urban studies, a field which has been seriously neglected," said President Pusey.

Carl F. Floe, '35, Administrative Vice Chancellor of M.I.T., is chairman of the new center's Administrative Committee, and Lloyd Rodwin, Associate Professor of Land Economics in the Institute's Department of City and Regional Planning, is chairman of the Faculty Committee which will set general policy for it. The director is Martin Meyerson, Williams Professor of City Planning and Urban Research at Harvard, who is also director of Harvard's present Center for Urban Studies.

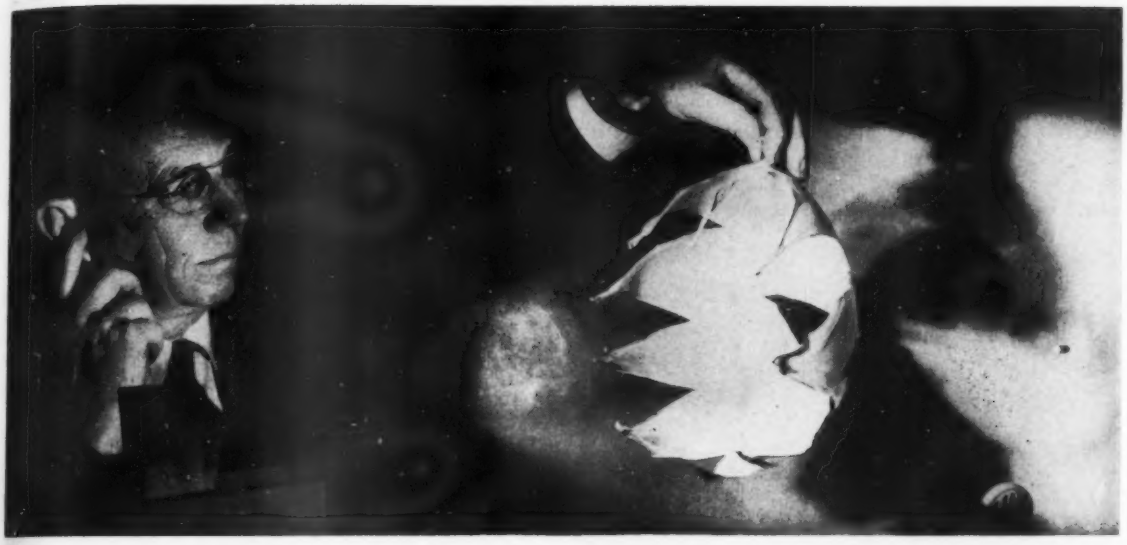
Lloyd Rodwin of M.I.T. (left) and Martin Meyerson of Harvard

The Center is expected to provide a stimulating environment for scholars engaged in urban research in this country and elsewhere. It will bring together the work of engineers, architects, lawyers, political scientists, philosophers, and experts in business, public health and other concerns of urban life, from the faculties of both schools.

An agreement signed by Presidents Stratton and Pusey emphasizes that, "Although urgent problems have led to demands for immediate effort, successful programs of action depend ultimately on the adequacy of knowledge of cities and regions. This knowledge at present is thin. Therefore, the principal responsibility of the Joint Center will be in basic research. An essential but secondary objective is to build a bridge between fundamental research and policy application at national and international as well as local levels. The findings of fundamental research must be made available through reports, books, seminars and other means valuable to the public official, the citizen leader, the professional and the private investor, here and abroad."

A Visiting Committee of outstanding national figures will be appointed soon.

A grant of $675,000 from the Ford Foundation will provide for the initial financing. Headquarters will be at 66 Church Street in Cambridge.



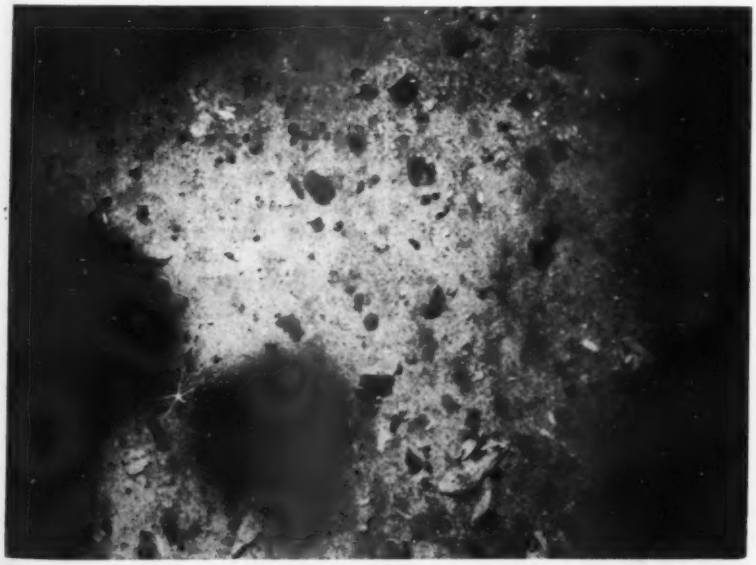
This photo of a balloon and bullet was taken with the tiny light in the left hand of the man on the cover of this issue. The microphone below the bullet fired the light. Bullets also have been photographed entering balloons and inside of them.

The Extension of Perception with Photography Continues

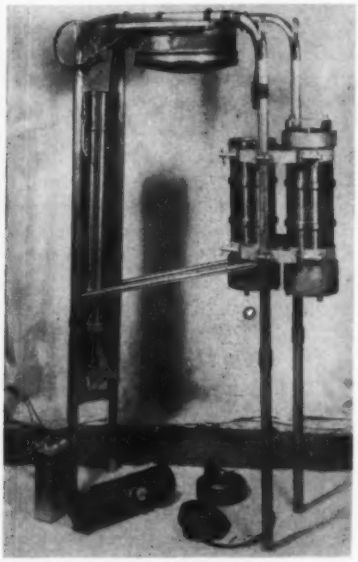
■ One thing has led to another so often in the laboratory of Professor Harold E. Edgerton, '27, at M.I.T. that it has become a mecca for explorers of everything from the ocean floor to teaching techniques. Prominent among its attractions are the big and little strobe lights with which "the doctor" is pictured on the cover of The Review this month. Prominent among its recent visitors was J. Y. Cousteau, the famous French underwater explorer and director of the Musée Océanographique de Monaco. The films that he showed one afternoon in Kresge Auditorium made many a man and boy late for dinner. More cameras and strobes for his ship *Calypso* and his submarine *Saucer* are in the process of being built at the Institute now.

Photographic speeds 100 times as great as that required to stop the bullet at the top of this page are attained now. Bits of exploding dynamite caps are being photographed, to help space explorers foresee the effects of bombardment by tiny particles when they sally forth to other planets. Simultaneously, Dr. Edgerton, chosen as Outstanding New England Engineer of 1958, is lending a hand to the experts in improving instruction in high school physics.

The additional projects to extend perception which lie ahead of Professor Edgerton usually seem endless.



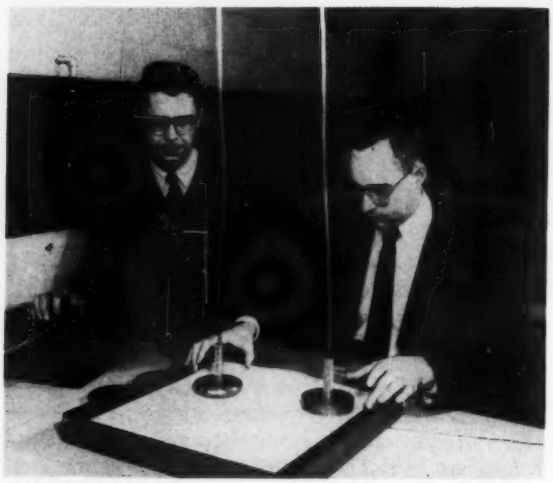
Ocean floor at a depth of nearly 25,000 feet. Photo was taken from Calypso *for National Geographic Society in Romanche Trench, off West Africa Coast. Tiny white spots may be living things. Sharpness of rocks puzzled experts. Mud caused dark blobs.*



Flashes from strobe unit at left will illuminate ocean floor, and two cameras at right will take stereoscopic views.

Students See Momentum Conserved

■ The pucks in the picture below are supported by thin films of compressed air that flow along their bottom surfaces. Because they are completely separated from the table top, the pucks move over it with very little friction. Students using them can see the principle of conservation of energy demonstrated more convincingly than previous generations saw it.



M.I.T. Photo
Robert G. Marcley (left) and William M. Whitney

This laboratory teaching apparatus won an American Association of Physics Teachers' $500 first prize this year for William M. Whitney, '56, Assistant Professor in the Department of Physics, and Robert G. Marcley, '47, of M.I.T.

Optimalized Flight in Space

■ In addition to charting interplanetary trajectories and devising means of staying on them, the M.I.T. Instrumentation Laboratory has coined a verb. It is "optimalize," meaning "to cause the performance to be optimum." A self-optimalizing person's work would be up to snuff no matter how much or fast his working conditions changed.

Obviously, there are few, if any, such persons, but a proud word such as "optimalize" is needed to convey the ideas set forth in a recent report by H. Philip Whitaker, '44, Joseph Yamron, '49, and Allen Kezer, '56, on "Design of Model-Reference Adaptive Control Systems for Aircraft." Under this drab but accurate title, they have described a method of making the automatic pilot of an airplane or spaceship "self-optimalizing."

The automatic pilots that now fly air liners to and fro were built to operate airplanes with known characteristics in known environments, which change only slightly, at speeds which soon will seem slow. The characteristics of these pilots have been carefully matched, in flight tests, with those of their aircraft. Flight-testing future vehicles, however, will be extremely expensive, and they will not only fly faster but will also encounter environmental changes far greater than men have previously mastered during their intensive efforts to conquer space.

On the Horizon

June 15, 1959 —
Morning: Inauguration of Julius A. Stratton, '23, as 11th President of the Institute.
Afternoon and Evening: 25th Alumni Day, with the Boston Pops Orchestra, again on the M.I.T. Campus.

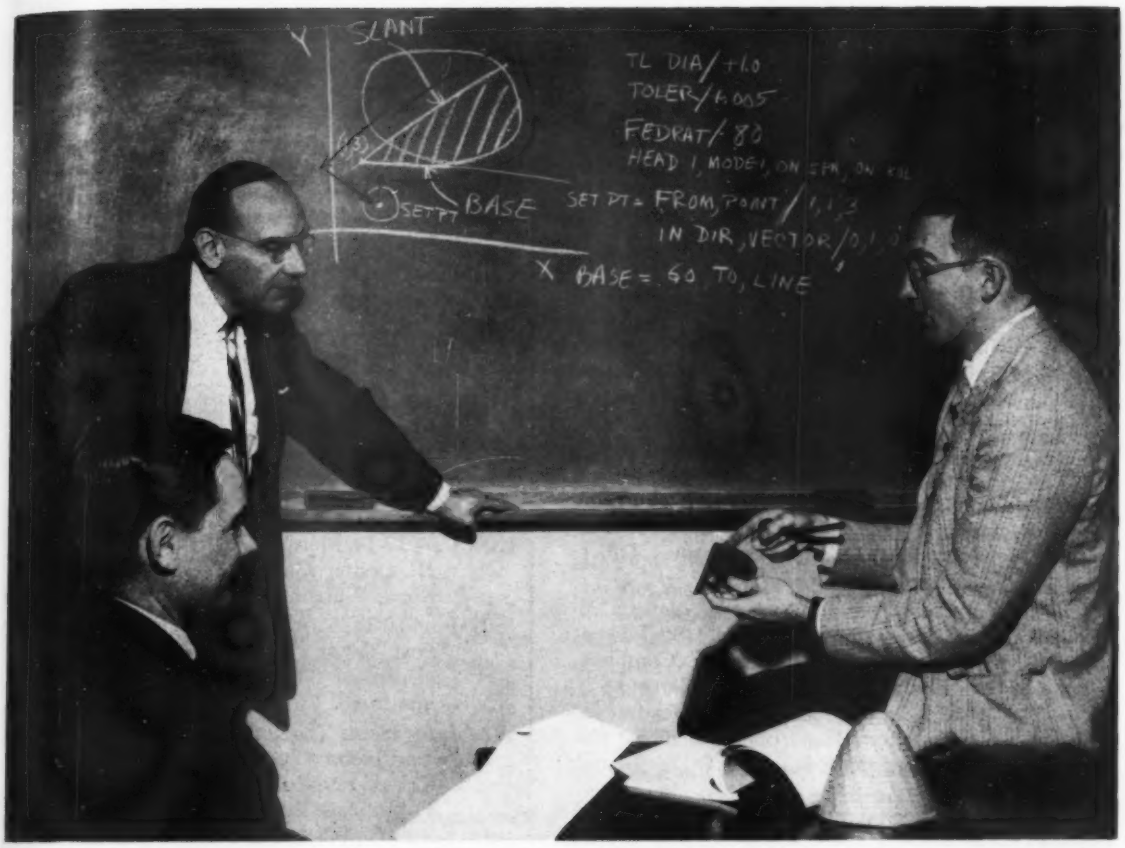
Suppose, for example, that you were cruising home from the moon at a satisfactory speed. Your ship would have to plunge from a near vacuum into an ocean of air that became increasingly dense. Its deceleration through this changing environment would have to be carefully controlled, but as you approached terra firma its responses to your guidance and application of the brakes would change. Your landing would be happier, certainly, if you could relax and leave the driving to a self-optimalizing automatic pilot.

But suppose, for a moment longer, that you were doing the driving. It would be nice, in your new vehicle on this new road, to have a reference book handy that would tell you how to get the most out of your spacecraft every split second. Such a reference book — suitable for an automatic pilot's use — has been designed in the Instrumentation Laboratory. It is called a "performance reference model," and looks so commonplace that a Harvard man might easily mistake it for a bedside radio. It will be a boon to air-and-space-travelers, nevertheless, because it can be prepared on the ground, without flight tests, from the specifications of their vehicles to enable a robot to bring them home alive.

Into this little black box, the automatic pilot can feed the same orders that it is transmitting to the spacecraft. The differences between the way the spacecraft actually is responding to those orders and the way this electronic reference model says it should be responding, then can be ascertained. With this information in its wires, the automatic pilot will be much better off. It can so alter its adjustments and expectations that it will be adapted to the spacecraft's capabilities in the environment at the instant. Thus it can "optimalize" the performance of the vehicle that it is flying.

This is not the only way in which an automatic pilot can be made self-adapting. The need for superior robots in the cockpits is so urgent that several laboratories have tackled the problem and found a variety of answers. One idea is to insert a test pulse, so the automatic pilot can "feel" what adjustments are needed. Another method has been dubbed the bang-bang system. Several systems are being tested in aircraft now.

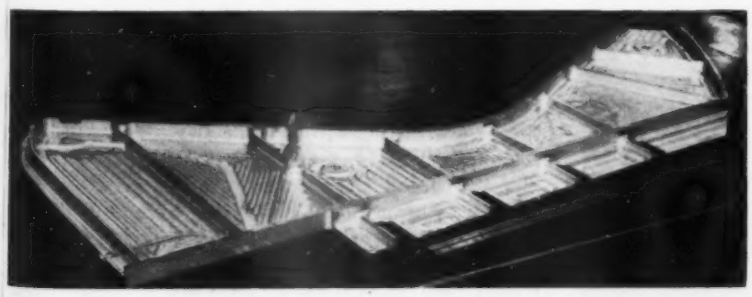
The M.I.T. system uses normal operating inputs, and thus eliminates the possibility of disturbances from feelers. It also permits the self-adapter to be independent of the automatic pilot's wiring, and this is an important advantage because it prevents a failure in the self-adapting circuitry from knocking out the autopilot. For these and other reasons, the Instrumentation Laboratory's investigators favor a model-reference control system, such as here described, to make the things that will fly tomorrow's aircraft and spacecraft "self-optimalizing."



At blackboard is John Francis Reintjes, Director of the Servomechanisms Laboratory; in foreground, Donald F. Clements, '55, APT project engineer; facing them, Douglas T. Ross, '54, head of the computer-applications group, describing items APT can turn out. A special language is used to instruct the computer, and some of these "APT words" are on blackboard.

The Advantages of APT

■ The importance of the APT (Automatically Programmed Tool) system, which the M.I.T. Servomechanisms Laboratory's staff has been kept busy explaining recently, can best be seen by studying the photos below. APT is considered a milestone in a quiet revolution which has been under way for 10 years in automatic production of aircraft-type parts. When this system is used, a digital computer prepares all tool-control data for actually producing a part from written specifications. The computer interprets design information and calculates appropriate directions for the tool-control system. This marriage of digital computers and automatic tools saves time, reduces costs, and strengthens our country.



A numerically controlled milling machine produced this part for a jet seaplane from an aluminum alloy in one-third of the time required for conventional milling. APT is another step forward in automatic production of components like this for aircraft.

This fitting for a jet airplane is another part typical of the complex components that APT will help to produce.

Individuals Noteworthy

■ Notable in the news since The Review's last issue were the 26 appointments, elections, or promotions presented below:

James G. Moir, '20, as Chief Engineer, New England Telephone and Telegraph Company . . . *Robert D. Patterson, '20,* as Vice-president – Finance, John Hancock Mutual Life Insurance Company, Boston . . . *Augustus B. Kinzel, '21,* as Vice-president, Engineers Joint Council . . . *Leonard D. P. Milano, '26,* as Executive Vice-president and Chief Executive Officer, Quebec Natural Gas Corporation;

Richard S. Briggs, '27, as Chief Engineer, Power Tube Division, Bomac Laboratories, Inc., Beverly, Mass. . . . *Russell P. Westerhoff, '27,* and *Stuart R. Fleming, '32,* respectively, as Chief Engineer and as Manager of the Engineering Department, Ford, Bacon, and Davis, Inc. . . . *W. Spencer Hutchinson, Jr., '29,* as Director of the Source Material Procurement Division, Grand Junction Operations Office, U. S. Atomic Energy Commission;

Jerry A. Cogan, '32, and *Charles W. Smith, '35,* respectively, as a Director and as Chief Staff Engineer, Esso Research and Engineering Company, affiliate of Standard Oil Company (New Jersey) . . . *Ralph D. Patch, '32,* as Regional Co-ordinator for Refining for the Eastern Hemisphere, Refining Coordination Department, Esso Standard Oil Company, (New Jersey);

John L. Person, '32, as Head, Metropolitan Sewer District, Louisville, Ky. . . . *Rolf V. Wallin, '32,* as Vice-president – Engineering, Union Carbide Chemicals Company, division of Union Carbide Corporation . . . *Charles E. Fulkerson, '33,* as a Director, Citizens and Manufacturers National Bank, Waterbury, Conn.;

M. Scott Dickson, '34, as Vice-president, W. and L. E. Gurley, Troy, N.Y. . . . *Frank W. Schoettler, '36,* as President, Struck Construction Company, Louisville, Ky. . . . *David A. Wright, '38,* as Chairman of the Board of Directors, American Waterways Operators, Inc.;

William R. Carlisle, '39, as Executive Vice-president, H. L. Yoh Company, Inc., Philadelphia . . . *Wayne J. Holman, Jr., '39,* as a Trustee, New York University . . . *John W. Pocock, '39,* as Chairman of the Executive Committee, Booz, Allen Applied Research, Inc.;

Francis W. Sargent, '39, as Executive Director, Outdoor Recreation Resources Review Commission, Washington, D.C. . . . *Rear Admiral Peter V. Colmar, '40,* as Commander, Fifth Coast Guard District, Norfolk, Va. . . . *Luke S. Hayden, '41,* as President, City Savings Bank, Pittsfield, Mass.;

Kennett W. Patrick, '46, as President, Consolidated Systems Corporation, subsidiary of Consolidated Electrodynamics Corporation, Pasadena, Calif. . . . *Herbert S. Brown, Jr., '47,* as Supervisor of Project and Flight Operations, Sikorsky Aircraft Division of United Aircraft Corporation . . . *Arye Y. Grozbord, '53,* as Vice-president, Assistant General Manager, and Director, Universal Cooler Co., Brantford, Ont.

(Continued on page 316)

Class Reunions in 1959

1894 June. Exact date and place not determined. Samuel C. Prescott, Secretary, Room 16-317, M.I.T., Cambridge 39.

1899 June 13. In Cambridge or Boston. William A. Kinsman, President, 348 High Street, Newburyport.

1901 June. In Dedham. Robert M. Derby, reunion chairman, Brookside Farm, Williamstown.

1904 June 14. Brae Burn Country Club, Newton. Reunion cochairmen: Carle R. Hayward, Room 35-304, M.I.T., Cambridge 39; Eugene H. Russell, Jr., 82 Devonshire Street, Boston 9.

1907 June 12-14. Oyster Harbors Club, Osterville, Mass. Philip B. Walker, Secretary, 18 Summit Street, Whitinsville.

1908 June 12-14. Melrose Inn, Harwich Port, Mass. H. Leston Carter, Secretary, 14 Roslyn Road, Waban 68.

1909 June 12-14. *50th reunion.* Snow Inn, Harwich Port, Mass. Francis M. Loud, reunion chairman, 351 Commercial Street, Weymouth 88.

1914 June 12-14. The Publick House and Treadway House, Sturbridge, Mass. Charles P. Fiske, reunion chairman, Cold Spring Farm, Bath, Maine.

1916 June 12-14. Chatham Bars Inn, Chatham, Mass. Harold F. Dodge, Secretary, 96 Briarcliff Road, Mountain Lakes, N.J.

1919 June 12-14 Wentworth-by-the-Sea, Portsmouth, N.H. Wilfred O. Langille, reunion chairman, Diehl Manufacturing Company, Finderne, Somerville, N.J.

1924 June 12-14. Oyster Harbors Club, Osterville, Mass. Paul J. Cardinal, reunion chairman, 195 Midland Avenue, Montclair, N.J.

1929 June 12-14. Bald Peak Colony Club, Melvin Village, N. H. Francis M. Mead, reunion chairman, 15 Waterhouse Road, Belmont.

1934 June 12-15. *25th reunion.* Baker House, M.I.T. Cambridge. Malcolm S. Stevens, reunion chairman, Room 1-139, M.I.T.

1939 June 12-14. Snow Inn, Harwich Port, Mass. William F. Wingard, reunion chairman, 26 Blithedale Street, Newtonville 60.

1944 June 12-14. Chatham Bars Inn, Chatham, Mass. Reunion cochairmen: (2-44) Burton A. Bromfield, 72 Woodchester Drive, Weston; (10-44) Kenneth G. Scheid, 24 Lee Street, Marblehead.

1949 June 12-14. Hotel Curtis, Lenox, Mass. Reunion co-chairmen: Russell N. Cox, 103 Loring Road, Weston 93; Kemon P. Taschioglou, Polaroid Corporation, 730 Main Street, Cambridge 39.

1954 June 12-14. Cliff Hotel, Scituate, Mass. Robert E. Anslow, reunion chairman, 935 Massachusetts Avenue, Lexington 73.

Universities in Transition

Our universities today present a panorama of perplexities. Emergence of research centers logically leads to a new tripartite structure of the university organization, able to cope with the problems of tomorrow.

by ARTHUR R. von HIPPEL

The author's plea for Interdepartmental Research Centers, vividly advanced in two previous articles — "Molecular Engineering" (March, 1956) and "Answers to Sputnik?" (March, 1958)—is here brought to an inspired climax. — Ed.

Panorama of Perplexities

WHAT has happened to the old ivory tower? Telephones ring incessantly; visitors swarm in droves through the laboratories; meetings crowd meetings; an ocean of papers blots out the horizon; and the wise men, once quietly guided by the star of Bethlehem, now frantically count time by the star of Moscow. Yet this turmoil is of our own doing. Universities showed that research pays, and huge laboratories sprang up for profit; universities devised new weapons, and countries bristle with laboratories for defense. What an outcome of a search for understanding of nature and for peace in our time!

Paradise lost; why not leave, instead of angling desperately for elusive government funds to fend off bankruptcy of our projects? Over there lures industry with high salaries and excellently equipped laboratories which offer the academic spirit a new home. Here we move at a snail's pace with untrained help toward new goals and watch in frustration those streamlined research machines, powered by university's educating and scouting, bulldoze broad highways past us into no-man's land.

The professor stays. He wants to help young people grow; to work on problems of his choosing; to live in the company of scholars. He hopes that universities will fight for truth and stand their ground fearlessly and without bias. His is the only stronghold of our times where prejudice dissolves and nations meet as comrades in friendly competition.

But is this still a stronghold of the mind? Relentlessly, as everywhere, the gap increases between administration and the working level. On the one side are the specialists, deeply immersed in studies; on the other, the policy makers with no time and means for proper communication. Between both parties stretches an ever-lengthening chain of command, transforming itself into an obstacle course preventing needed decision — *Parkinson's law* in action.

To beat this law, conditions must be changed. We must find time and fellowship for synthesis of knowledge in all fields. The visions then emerging are large scale and can be understood by others; when inspired, they should lead to proper action.

The universities should show the way. They feel the drive for synthesis of knowledge but seek prescriptions that have served before. This is no situation previously encountered; this means rebuilding! A new university strives to emerge, concentrating its pioneering tasks in interdepartmental research centers. Here are the new partners required by administration for the formulation of imaginative policy. Through such Centers, freely growing in spirit of philosophical thinking and with full voice and responsibility in their realm of competence, universities can be citadels of strength. Let us visualize how they might develop.

The Emergence of Research Centers

In a university, natural research units form spontaneously around scientists and engineers who dedicate their lives to the development of some challenging area of knowledge. If such programs and interest

M.I.T. Photo

Dr. von Hippel, Professor of Electrophysics, is the founder and stimulating director of the Laboratory for Insulation Research.

partly overlap and together open much broader vistas of understanding by which the individual contributions assume a deeper meaning, the prerequisites exist for forming a "Research Center" by voluntary federation.* A "Research Center," as visualized here, thus consists of a cell structure of individually functioning laboratories, each with an inspiring research program, but together creating a new spiritual entity.

Any concentration of men and facilities invites the temptation to use it as an instrument of power if no safeguards are provided. The safeguards for a university are freedom of the individual professor and decentralization of responsibility. A "Center" needs no director as commander in chief but as a friend and understanding discussion partner of the individual experts who are thinkers in their own rights. A "Center" should not have an over-all budget, from which the support can be parceled out to the various laboratories on the basis of likes and dislikes. Freedom, under present conditions, can only be preserved if each project receives its direct contractual support, earned by the merit and strength of its research program. A "Center" should not create joint facilities with the approach of a supermarket: large units produce cheaper service. This slogan of mass production is not true for universities. Small machine shops, owned by individual laboratories or laboratory groupings which can keep them busy full time, are preferable to one large one because the machinists remain trusted personal friends and helpers of staff and students. Business managers of small laboratory units can act as educators in their own realm of responsibility and, as helpers of the scientists, take over the nonscientific work load on a personal basis, in contrast to an over-all management operating anonymously through an echelon of employees. We must renounce the usual trappings of centralizing power with its means of coercion and rewards.

* The author cannot judge how far these considerations are relevant for the humanities.

M.I.T. Photo

Dr. Alexander Smakula is shown with one of the many types of crystals in the Laboratory for Insulation Research.

What then will pull such an aggregate of laboratories together and make it much stronger than its parts? The primary motive must be that the scientists and engineers involved enjoy each other's company and that their projects draw stimulation from each other's existence, with full respect for mutual privacy and independence. If these prerequisites exist, everything else follows automatically: mutual support with tools and knowledge; creation of joint facilities that are too expensive for, or too rarely used by, individual laboratories; acquisition of an integrated space area, built for the needs of the "Center" and the strategical placing of its tools; and handling of joint affairs through a steering committee.

The scope of these joint affairs immediately shows the new strength such a coalition would acquire. The "Center" as a whole could act through its interdepartmental faculty with a breadth of understanding of large-scale problems that no individual can command. This integrated knowledge would express itself logically in the creation of library facilities and of an information center which organizes the stream of disjointed reports and publications for a whole area into readily accessible, prescreened information. Such "living information," continuously tested by and drawn from expert knowledge, is needed for the defense effort of our country and for long-range planning. There is no merit in augmenting the already unmanageable flood of papers by setting up new information and translation bureaus far from the firing line.

A "Center" would be expected to create an inspiring program of interdepartmental courses for the graduate school and to provide an atmosphere of wide-ranging philosophical thinking for doctorate and postdoctorate research. It would offer government and industry an unequaled opportunity to reward and refresh their qualified scientists and engineers by a period of advanced integrated research experience through a fellowship program. While not actively involved in the undergraduate school, a Research Center would provide a ready forum for the discussion of a teaching program that introduces the undergraduate student into its world of expanding knowledge and prepares professors for such teaching.

The New Tripartite Structure

If the university of tomorrow is built as a three-way partnership – Administration, Departments, and Research Centers – this structure will function effectively only when evenly balanced.

The research centers, newcomers to the scene, need a congenial faculty of highest competence to co-operate as nonpartisans in a challenging interdepartmental enterprise. They must have the right to propose appointments which assure the efficiency of existing laboratories and provide nuclei for new ones where required. This right is balanced by the obligation of finding the money for their operations.

The departments cannot be expected to greet a priori the advent of research centers with joyful composure. After all, the pulsing scientific life seems to emigrate, and in essence only the educational problems of the undergraduate and graduate school are left. Actually, however, the loss is only a fictitious one: no department head would attempt today to direct the various research projects falling to his administra-

tive area. His job is to help create conditions for healthy growth, and this opportunity in the university of the future is expanding. The professors of the centers will, in general, be simultaneously members of the various departments and deeply responsible to the departments for the education and welfare of their students. It needs no prophet to foresee that only those departments of science and engineering will remain strong and able to attract first-rate students which show pride, affection, and active support for the research centers and their wide-ranging activities. The appointment of professors for the Centers will not become a football of prerogatives if the departments reserve the right of approval for prospective appointees in their fields, and the centers assume the salary requirements resulting from such appointments. A fraction of the overhead charges presently paid by the research projects for over-all university expenses could serve this purpose.

Administration holds the key position in helping the emergence of research centers as responsible allies. Here is its unique chance to redistribute the burden and to strengthen the universities as a great moral power, where each partner speaks about his own tasks and visions with imaginative conviction.

A "Center for Modern Materials Research"

Drums are being beaten for the creation of one "Super-Center for Materials Research" under government auspices. Instead of such artificial concentration of our national resources, the organic growth of university centers for materials research might be supported; this would serve the additional need of educating tomorrow's generation. In sketching here a prototype "Center for Modern Materials Research," the author hopes to sharpen the preceding general considerations by visualizing a center structure in his own field of knowledge.

Fundamental research in the last few decades has created a deeper understanding of the laws of "Molecular Science" and of their applications to engineering problems, "Molecular Engineering." A broad new discipline emerges, "Molecular Science and Molecular Engineering," comprising the structure, formation, and properties of atoms, molecules, and ions; of gases, liquids, solids and their interfaces; the designing of materials and properties on the basis of this molecular understanding; and their imaginative application for devices. All scientists and engineers dedicated to this type of modern materials research become natural allies.

When thinking about materials from the point of view of structure and binding forces, one finds that their electric, magnetic, and mechanical parameters are the most fundamental ones. These should be measured and interpreted as functions of temperature and pressure, frequency and field strength, structure and composition. From the standpoint of classical approaches, this prescription has no revolutionary implications. There exists a formidable array of materials and of testing machines that record responses under stress and pressure, heat, chemical attack and other abuses in slow and fast stages up to final destruction. Still, for our objectives these data are in general useless because they are taken on the wrong objects with the wrong methods. We need materials composed of

M.I.T. Photo

Magnetic resonance spectra are measured in the Laboratory for Insulation Research by Assistant Professor Perry A. Miles.

specified atoms and molecules in prescribed arrangements, carefully preanalyzed by nondestructive means and then investigated in preselected areas and directions with a variety of molecularly meaningful methods. In consequence our Center needs facilities for growing crystals, preparing defined multicrystalline samples of metals and ceramics, producing polymers, glasses and liquids to order, handling gases from vacuum to high compression, and investigating all these materials with tools of tremendous sensitivity and selectivity.

Faced with this formidable prospect, one is inclined to look for an escape clause: Why not set up one crystal-growing factory for the country, from which the desired materials stream on conveyer belts, ready for scientists and engineers with bright ideas? Unfortunately, we demand more than picking out diamonds for engagement rings. We need crystals built as perfectly as possible to reach standards for ultimate performance. Vice versa, crystals with accurately prescribed imperfections are required, since the most startling changes in behavior result when atoms or rows of atoms are displaced, electrons or electron defects introduced, addition agents added, substitution made or lattices laced with interfaces and surface layers. Much of the solid-state work done today is of little value because carried out on undefined materials.

The conclusion is that producing materials for fundamental studies cannot be a simple supply operation; it is a scientific activity closely integrated with the search for answers to specific questions. There should be primary crystal-growing laboratories, specializing in problems of the growth processes as such and in the molecular analysis of the specimens result-

(Concluded on page 314)

The Great Stairway for Ships Opens

The St. Lawrence Seaway creates ocean ports 2,000 miles inland and 602 feet above the sea; the largest lake ships will use it, and bulk cargoes will constitute most of its traffic

by J. J. ROWLANDS

It was the plunging rapids of the St. Lawrence River that stopped Jacques Cartier, in the Sixteenth Century, when he sailed 1,000 miles up the great Canadian waterway in the belief that he had discovered the legendary passage to the Orient. This month the St. Lawrence Seaway will be opened to navigation. All but the world's largest ships then will be able to steam past the rapids, and move step by gigantic step through the Great Lakes to ports more than 2,000 miles inland and 602 feet higher than the Atlantic Ocean.

The Seaway is not only the fulfillment of a dream of three centuries and a magnificent engineering achievement, but also a significant monument to international friendship and co-operation.

As a two-nation project, it includes both the new deepwater canal system and power plant in the upper St. Lawrence, and the long-established Welland Canal between Lake Ontario and Lake Erie. The locks of the new Seaway follow with only slight variations the dimensions originally established for those of the Welland Canal, having a length of 860 feet, a width of 80 feet, and a depth of 30 feet over the sills. The entire waterway, as well as channels in the Great Lakes and through the Sault Ste. Marie Canal which connects Lakes Superior and Huron, will have a depth of at least 27 feet, and this will permit the largest of the Great Lakes grain carriers to take full cargoes to the sea.

The St. Lawrence River, from Montreal's Harbor eastward to the Gulf of St. Lawrence, already has a uniform depth of 35 feet, with an average flow of 241,000 cubic feet per second. Because the river carries no sediment and flows through a rocky channel for most of its course, maintenance of depth for navigation is not a serious problem. The distance from the mouth of the St. Lawrence to Europe is approximately 1,000 miles less than the voyage from eastern United States ports; from Chicago to Liverpool by way of the Seaway is only 4,120 miles.

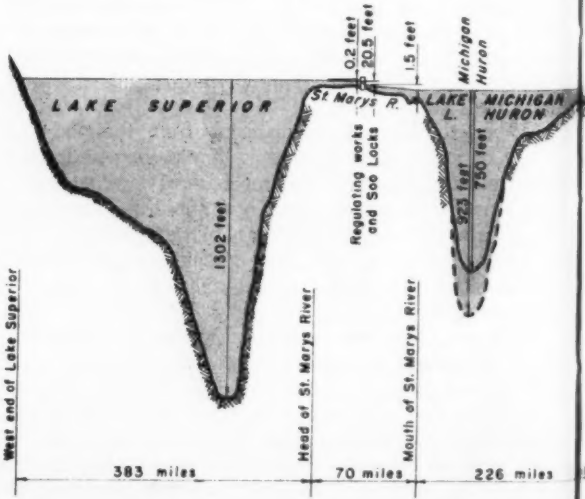
As early as 1700, attempts were made to build a waterway, without locks, around the Lachine Rapids to Lake Louis, some 15 miles upstream from Montreal. This effort was abandoned because of its cost, but several small canals were built later around sections of the rapids.

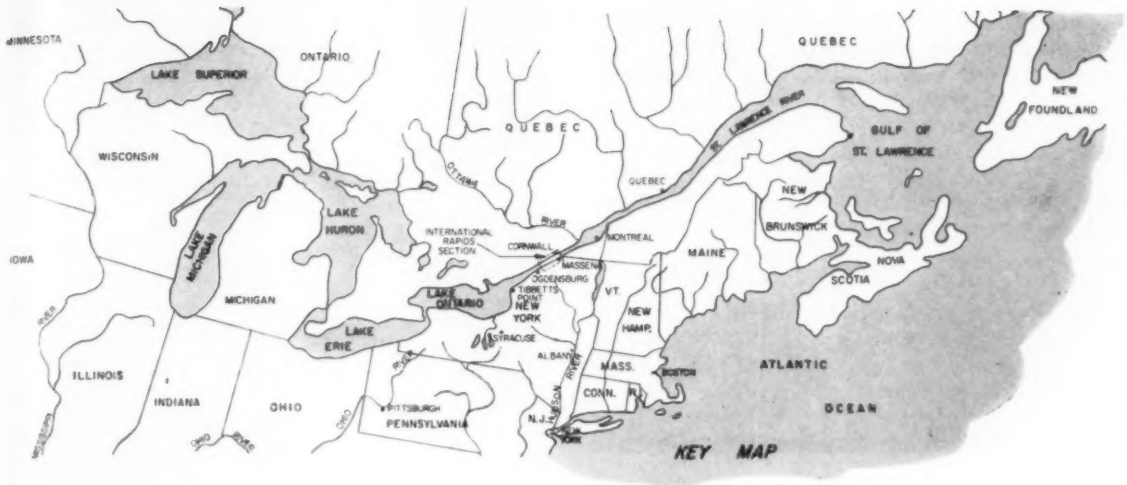
As trade developed, the need for completing a through waterway between Montreal and Lake Ontario became more urgent. Finally, in the spring of 1821, work was started on a canal 20 feet wide, with locks 110 feet long and four feet deep, to by-pass the Lachine Rapids. This 15-mile section along the north shore of the river was completed in 1825, the year that the Erie Canal was opened, and a navigable waterway from deepwater at Montreal to the level of Lake Ontario was completed in 1848. This canal system later was brought to a depth of nine feet, and in 1901 to 14 feet, a depth which limited its use to vessels about 250 feet long, with 43-foot beams and 2,500 tons capacity.

How the Cost Rose

The new Seaway is much more capacious. It will accommodate ships 768 feet long and 75 feet across the beam, with a bulk capacity of 25,000 tons, and an operating draft of 24½ feet. These dimensions open the Great Lakes to 80 per cent of the world's shipping.

A whole series of canals has been superseded by the St. Lawrence Seaway. These include the one by-passing the Lachine Rapids, the Soulanges Canal which carried shipping around the Cascades, Cedar, and Coteau Rapids, between Lake St. Louis and Lake St. Francis, and the Cornwall Canal which overcame the Long Sault Rapids.





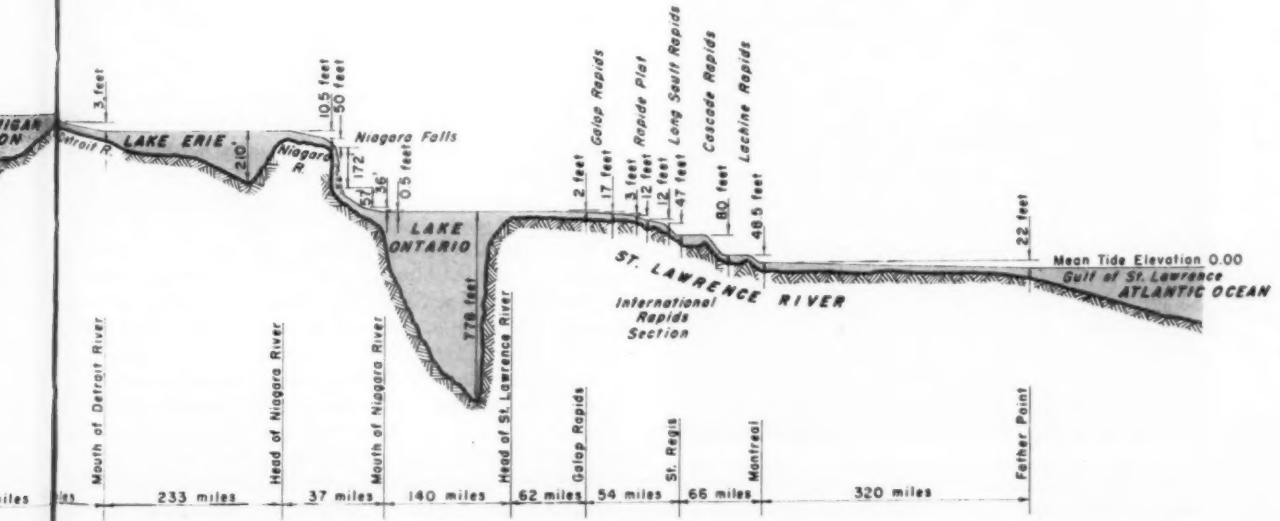
In 1930, when President Hoover opened the Ohio River to nine-foot navigation from Pittsburgh to Cairo, Ill., he said: "One of the most vital improvements to transportation on the North American Continent is the removal of the obstacles in the St. Lawrence River to ocean-going vessels inward to the Great Lakes." As he spoke, Canada was completing the great Welland Canal, and Mr. Hoover estimated that, after disposal of electric power, construction of the St. Lawrence River projects could be completed for less than $200,000,000.

But that was 29 years ago. The cost of the Seaway now being opened will be more than a billion dollars, of which $600,000,000 will be for hydroelectric development, and $450,000,000 for the waterway. Canada will pay two-thirds of the total cost of the project. Her share for the Seaway, including improvements in the Welland Canal, will be approximately $329,000,000, while her share for power development will be about $300,000,000.

The new Seaway begins its 226-foot climb to Lake Ontario just below Montreal Harbor and follows the south shore of the river to Lake St. Louis, a distance of 20 miles. The old canal lies on the north side of the river. The new route was chosen to avoid congestion in Montreal Harbor and to permit further expansion of the harbor and development of new industrial areas. The new route also simplifies highway and rail communications between Montreal and the south shore.

To provide the standard overhead clearance of 120 feet, a section of the great Jacques Cartier Bridge over Montreal Harbor was raised. Vertical lift bridges were provided at the crossing of the famous old Victoria Bridge, a few miles upstream. Two other bridges, the Canadian Pacific and the highway crossings at the head of the Lachine Rapids, were modified. A new international suspension bridge also spans the Seaway now near Cornwall.

The first lock in the Seaway is at St. Lambert, Quebec, three miles upstream from the entrance; and the second, Côte Ste. Catherine lock, is 11 miles above the entrance. Two large turning basins are located in this section, which brings the canal to Lake St. Louis and clear sailing to the Beauharnois locks, 12 miles to the west. Here the Seaway rises through two locks, reaching the level of the Beauharnois Power Canal which was built in 1932 with a



depth of 27 feet in anticipation of future waterway requirements. Construction of the locks was all that was necessary to complete this 16-mille section of the new waterway. A four-lane highway tunnel passes beneath it.

The Beauharnois Canal leads westward into Lake St. Francis, which is 29 miles long and required only partial dredging to make it navigable for deep-draft vessels.

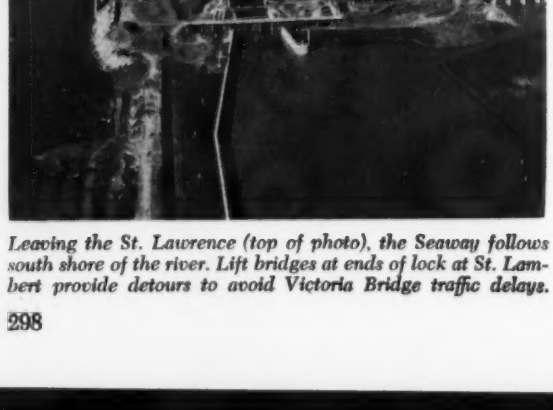
Up 92 Feet in 47 Miles

The International Rapids section of the Seaway reaches from the head of Lake St. Francis to Chimney Point, just below Ogdensburg, N.Y., a distance of 47 miles with a difference in elevation of 92 feet. This is overcome by the Bertrand H. Snell and the Eisenhower locks, each of which raises ships half the total lift.

The Eisenhower Lock, 860 feet long, brings vessels to the level of Lake St. Lawrence, a vast new power pool 30 miles long and four miles wide created by Long Sault Dam. This structure is 2,960 feet long and 120 feet high, and stands between the west end of Barnhart Island and the New York State shore of the river.

The power dam is between the lower or eastern end of Barnhart Island and the Canadian shore. It is 3,300 feet long and its 32 turbine generators, half belonging to the United States and half to Canada, have a total capacity of 2,200,000 horsepower. The plant, second only to Grand Coulee in capacity, is operated by the Power Authority of the state of New York and the Hydro Electric Power Commission of Canada.

At the western end of Lake St. Lawrence, 25 miles upstream from the power dam and on the Canadian side of the waterway, is Iroquois Dam and the last lock which lifts ships to the level of Lake Ontario. The dam and lock are part of a water-control system designed to maintain the lake at the desired level for power production at all seasons.



Leaving the St. Lawrence (top of photo), the Seaway follows south shore of the river. Lift bridges at ends of lock at St. Lambert provide detours to avoid Victoria Bridge traffic delays.

In St. Lambert Lock opposite Montreal, ships take 15-foot step toward level of Lake Ontario. In foreground is a fender boom supporting steel cables which could stop a 30,000-ton ship.

As a special safety feature, all of the Seaway locks have pairs of wire rope fenders across the upper and low ends. These guard the locks against damage by vessels moving out of control beyond the prescribed limits for mooring. If struck by a ship, a fender cable unwinds from two drums working against four friction brakes. These fenders are designed to stop a 30,000-ton vessel moving three miles an hour.

Emergency Provisions

The Eisenhower Lock, on the United States side of the waterway which also helps control the power pool, is equipped with an emergency vertical lift gate located at the upstream end and recessed in the base of the structure below the upper sill. This gate is designed to operate in an emergency against a hydraulic head of more than a million pounds pressure.

The gates of the two locks in the American section are of the miter type, the lower gate measuring 46 by 84 feet and weighing 280 tons. Tainter-type valves control the interchange of water in these locks, and the introduction of water to raise a vessel is accomplished with so little turbulence that a canoe passing through a lock with two vessels had no trouble whatever.

The equipment for moving ships through the locks is believed to be the most efficient in the world. Since heavy lines must be used to moor ships during lockage, line haulers resembling the standard industrial car hauler operate on top of the lock walls. All locks have stand-by power plants. The movement

of ships, in and out of the locks, is controlled by lights quite similar to those used by a highway traffic system.

On entering a lock, a vessel is required to make a landing and put ashore two men to assist in handling lines. Heating throughout the canal control buildings is electrical. On sector gates, heaters are installed at the sealing faces as well as in the hollow quoins of the miter gates. These units are energized at a temperature of 30 degrees Fahrenheit to prevent freezing. All locks are equipped with very effective surface lighting for lockage operations.

Lock-gate valves and emergency fenders can be operated either from the lock or remote-control points. Ordinarily, however, all operations are carried on from control rooms at the ends of the lock.

High Tide! Low Tide!

Recesses are provided at both ends of each lock for the placing of stop logs, the chief purpose of which is to permit unwatering for maintenance and inspection. Each stop log consists of two horizontal welded plate girders with a skin plate between the flanges on the water side. A horizontal seal of plaited nylon rope is provided between each log, and rubber seals are used at each end. The logs are placed by means of stiff-legged derricks.

Vertical deep-well pumps installed at the lower end of every lock are used to remove more than 20,000,000 gallons of water from the chamber. Each pump is capable of beginning its task by discharging 19,600 gallons per minute against a 10-foot head, and will also deliver 12,900 gallons per minute against a 50-foot total head as the end of the unwatering process approaches.

Canada's Iroquois Lock has a usable length of 768 feet, the length of the main lock chamber being 1,200 feet; and with its upper and lower approach walls the structure is 6,100 feet long. The lock walls are 47 feet high and 34 feet wide at the base. This big lock has two sets of sector gates at each end which can be opened for both filling and emptying, thus eliminating filling culverts and valves. This is possible because there is a difference of only six feet in the upper- and lower-water levels.

A sector gate consists of two vertical sectorial prisms, the radius of each being 48 feet with a 43-degree angle between its radial axis. Each gate is 43 feet high and the sector framing consists of seven horizontal structural steel frames and a skin plate on the outer faces of curved steel girders. The opening and closing time to fill or empty a lock, with a capacity of 20,000,000 gallons, is five minutes.

Nearly a Day Saved

Most of the Seaway locks can accommodate vessels in tandem, and the time required for transit is approximately 40 minutes. The total time for passage through the St. Lawrence section of the Seaway will be from 12 to 20 hours shorter than transit through the 21 locks of the old canal.

Above the Iroquois Lock and through the Thousand Islands section of the river, dredging and blasting have brought the channel to standard draft through to

Dwight D. Eisenhower Lock opened last summer. This Canadian canaler was last of 5,200 ships which went through old 14-foot canal between July 4 and December 8, 1958.

Lower Beauharnois Lock, 80 feet wide, 30 feet deep, with a usable length of 730 feet, is typical of Seaway locks. Combined lift of this one and its twin is 82 feet.

Here you see a stop log being lowered in keyways in canal walls in preparation for installing the two five-foot-thick leaves of a gate which will form an arch against the water load.

The Iroquois Lock and Dam, center of one of most beautiful sections of Seaway, control a power pool and navigation system in Lake St. Lawrence, 30 miles long and up to four miles wide. This lock is largest of seven steps up to Lake Ontario.

Lake Ontario. From this point it is 159 miles clear sailing to the entrance of the Welland Canal and the climb past Niagara to Lake Erie.

The early traders who originally reached the Great Lakes, by way of the St. Lawrence, seemed for a time to be more concerned with opening up navigable waterways within the Great Lakes region than in the river. The North West Fur Company started construction in 1796 of a small lock to overcome the rapids of the St. Mary's River joining Lake Superior and Lake Huron at Sault Ste. Marie. This system made it possible for canoes to move from one lake to another.

The Welland Canal

Reports by English and French explorers and traders of the day, however, almost invariably considered a waterway around Niagara Falls an impossible undertaking, and it was not until November, 1824, that a group of Canadians organized a company to build a canal across the Niagara Peninsula. As the heaviest type of earth-moving equipment at that time was the horse-drawn scraper and black powder, the task was formidable. Nevertheless, the Welland Canal Company moved in, undismayed at the prospect of constructing 40 watery steps of wood, 110 feet long, 22 feet wide and eight feet deep, up the towering escarpment lying between Lake Ontario and Lake Erie. Remains of this monumental feat of early Canadian engineers are still in evidence.

Work on the present Welland Canal was started in 1913 and it was opened to navigation in 1933, after delays because of World War I. It emphasized the dramatic significance of deepwater navigation from the headwaters of the Great Lakes to the entrance of the St. Lawrence River. In the heart of the continent lay an industrial and agricultural empire and a water system of more than 100,000 square miles which, even at that time, carried the greatest fleet of ships in the world with a cargo tonnage greater by 18,000,000 tons than the combined commerce of the Suez and the Panama canals.

Whereas the first Welland Canal had 40 locks, the present waterway has only eight, three of which rise in flight formation like the Gatun locks at Panama. With locks 859 feet long between pintles, 80 feet wide and a depth of 30 feet over the sills, the Welland Canal's usable lock length is 820 feet. This accommodates most of the large Great Lakes bulk carriers. Its channel depth between locks until recently was 25 feet in some sections, and dredging in these parts has increased the depth now to 27 feet. The foresight of the Canadian government in building the canal has been shown by the minor nature of the alterations needed, nearly 30 years after its completion, to match the facilities of the new Seaway section in the St. Lawrence.

In discussions of the potentialities of the St. Lawrence Seaway so much emphasis has been placed on the passage of deep-draft ocean vessels into the Great Lakes that the equally important opportunity for the largest lake ships to move down to the sea has been overshadowed. Furthermore, so much attention has

been directed to increases in the general cargo trade with foreign countries that the importance of bulk cargoes has been discounted. There is every indication now that 85 per cent of the traffic will be bulk cargoes including iron ore and nonferrous metals, grain, coal and coke, petroleum and wood pulp.

Change in Shipping Pattern

The pattern of shipping on the old canal route brought the big grain ships to Port Colborne on Lake Erie, or to Prescott, Ontario, at the west end of the shallow draft canal where cargoes were transshipped to small canalers. It often required seven or eight of these vessels to handle the cargo of a big laker.

Although there will be an increase now in the number of foreign vessels moving into the Great Lakes with general cargoes and picking up return loads of grain, there will also be a dramatic increase in the movement of lake vessels to transshipment points at Montreal and on the river below. The grain trade of Canada and the United States is certain to undergo striking changes. Vessels up to 700 feet long are already under construction to meet the expected increase in bulk cargo transportation.

Montreal is spending more than $2,000,000 for new facilities below the present harbor for efficient transshipment of cargoes from lakers to seagoing vessels. This thriving port now has a grain elevator capacity of nearly 22,000,000 bushels.

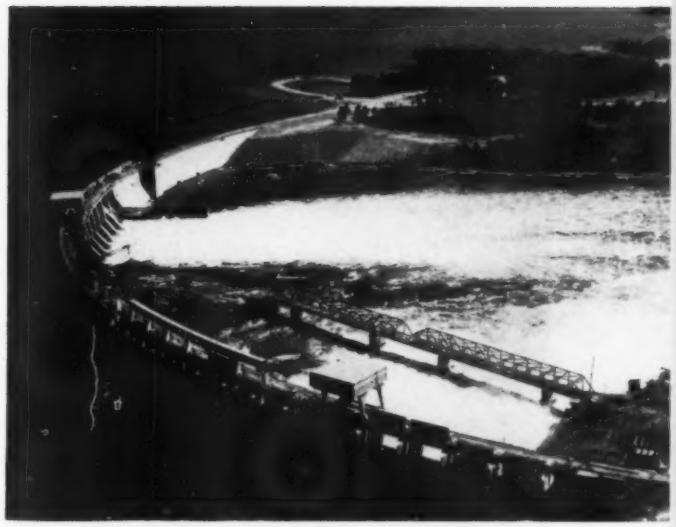
An American company is preparing to establish a transshipment grain elevator at Baie Comeau, hundreds of miles below Montreal and not far from the Gulf of St. Lawrence. It is quite possible that transshipment of grain could be made advantageously at the Seven Islands ore port on the north shore of the Gulf. Big lake ships could discharge grain for transshipment to ocean vessels and return loaded with ore. Another possibility is that lake vessels might continue as far as Sydney, Nova Scotia, Canada's great mining center, to discharge outbound bulk cargoes and load coal for return to the great lakes.

It would not be surprising to see some of the bulk traffic from the lakes move as far as Halifax for transshipment. Tramp steamers, bringing cargoes up the St. Lawrence as far as Montreal, may find it profitable to pick up return cargoes of grain there, or at such river transshipment ports as Sorel, Tres Rivières, or Quebec. The inland fleet of bulk carriers, American and Canadian, however, is likely to carry nearly all the domestic grain moving down the St. Lawrence.

Ore Shipments

The Seaway also will have an important effect on the movement of iron ore from Seven Islands. In 1957, more than 2,000,000 tons were carried up the river through Lake Ontario to Lake Erie. Most of this ore was brought to a transshipment point just below Montreal for transfer to canalers. An estimated 40,000,000 tons are expected to move through the Seaway this summer.

In anticipation of increasing trade with foreign countries, many of the Great Lakes ports are increasing harbor depths and building new port facilities. Fort William and Port Arthur, the huge grain ports of



The Long Sault Dam controls water level at power dam. Big gantry crane (lower center) is used to adjust sluice gates. Beyond may be seen a mooring basin for pleasure craft, as well as a beautiful park which is used as a recreational area.

western Ontario, are constructing a co-ordinated port area. Major changes are being made at Sarnia, the big petro-chemical center on the St. Clair River, and improvements also are planned at Windsor, center of the Canadian automotive industry. Hamilton, on Lake Ontario, an important steel center, and Toronto also are developing new port facilities. Most of the big United States lake ports already served by the big ships are increasing the depth of their harbor channels and adding docking facilties in expectation of a flourishing general cargo trade.

In 1958 with traffic limited to the old 14-foot canal, traffic amounted to 13,000,000 tons, much of it outward bound. This year it is expected that at least

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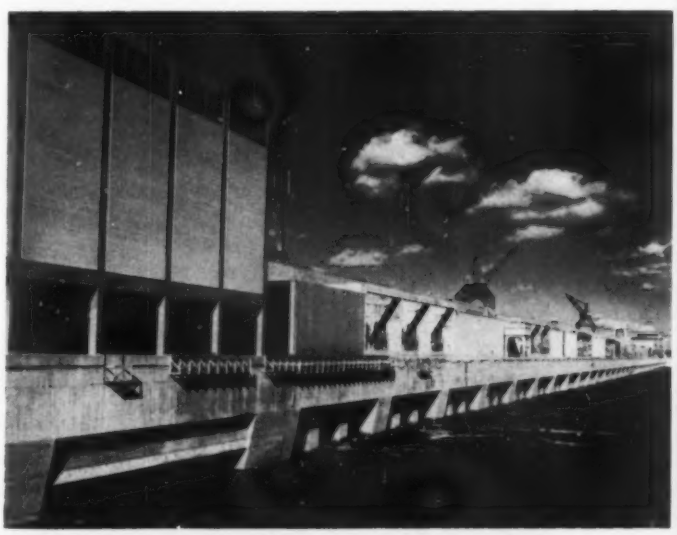
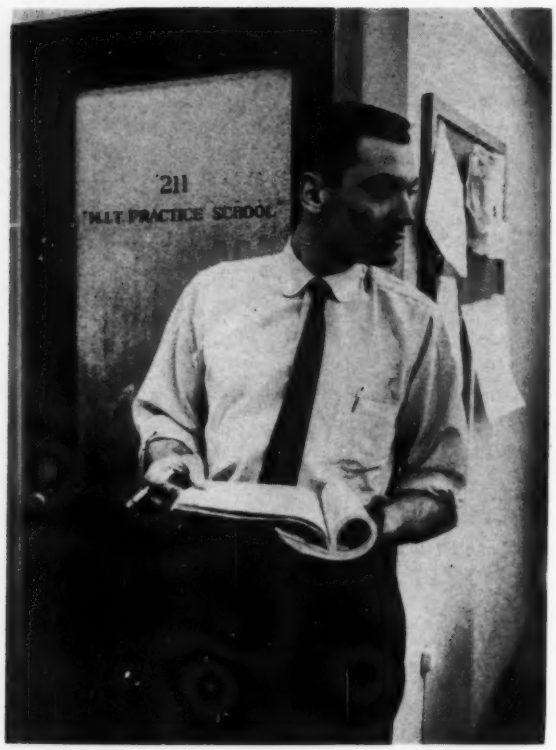


This is 3,300-foot international power dam's downstream face. Its 32 turbines generate 2,200,000 horsepower. Only Grand Coulee and Niagara exceed it.



M.I.T.'s Campus in New Jersey

REAL engineering problems are being solved, in the environment of complex industrial plants, to the satisfaction of both resident members of the Faculty and plant managers, at new M.I.T. Stations of Chemical Engineering Practice in New Jersey. These extensions of the campus embrace the Esso Standard Oil Company's Bayway Refinery in Linden and the American Cyanamid Company's organic chemicals plant in Bound Brook. Twenty students are spending nine weeks at each of these plants this term. Since 1917, the Institute's School of Chemical Engineering Practice has operated Field Stations. Their primary objective is to develop the student's ability to apply fundamentals by assigning him to a variety of challenging plant problems. Emphasis is placed upon the development of abilities to apply basic principles and good common sense to the solution of technical problems encountered in industry.

Professor Walter G. Whitman, '17, Head of the Department of Chemical Engineering, points out that the assignments given to students in these plants show them the importance of economic factors, human relations, and communication of one's ideas. "This type of program may be compared to the hospital internship of a young doctor," says Garrett Hill, manager of the Cyanamid plant. "Frequently," adds Ross Murrell, manager of the Esso Refinery, "they yield important technical contributions. The companies' use of these results greatly stimulates the confidence of the students in their engineering ability."

Searching the literature is part of the job. Richard P. de Filippi (above) *finds reports on new developments clarify a problem to which he was assigned at Bound Brook Station, New Jersey.* Below *you see graduate students Kishore V. Mariwala (left) and Robert S. Slott (right) listening to a problem proposed by Thomas F. Seamans. A resident Faculty member supervises the work at each plant.*

Photos — Werner Wolff from Black Star

American Cyanamid Company

Above: *Albert W. Karnath replaces a nozzle in a tower used for spray chilling a dye, in his course of studies at Bound Brook.* At left: *Mr. de Filippi is upstairs and B. C. Eusebio downstairs during an experiment with Bayway Powerformer equipment.* Below: *Leo F. Kelley listens to an expert explain problems of operating Powerformer at Esso Bayway Refinery.*

Photos at left and below — Wm. R. Frutchey

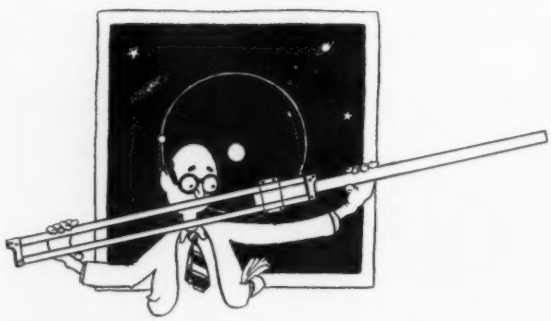
TALK OF OUR TIMES

Space Swallows the Shallow Salesman

Charles S. Draper, '26, Head of the Department of Aeronautics and Astronautics at M.I.T., is well qualified to speak of nontechnical as well as technical aspects of Space Age engineering. Why must many of the ablest engineers now do work that formerly was done by the sales department? Why must inventions now be made almost on schedule? In a recent talk to the Engineering Societies of New England, Dr. Draper explained:

■ The future will surely bring a long line of truly astronautical vehicles that will carry instruments and men well away from the earth, its atmosphere, and its gravitational field. Trips to the moon, Mars, Venus, and perhaps to other planets, may never show rewards great enough to become commonplace, but they will surely become possible.

Engineering for the Space Age must accept the challenge of doing many jobs that are similar to those of the past and many other jobs that are new in the sense that they are beyond anything in human experience. Practicing engineers who become involved, either from choice or necessity, in Space Age work nearly always need to enlarge their horizons and to deepen their knowledge in certain areas.



The Space Age has not only added greatly to the range of scientific knowledge required for mastery of new technical problems but also has radically altered the nontechnical aspects of the environment in which engineers work. In order to advance toward the more responsible and distinguished positions in his profession, an engineer must have a good understanding of this environment and demonstrate skill in dealing with its problems. Similar situations have occurred many times in the past, but several features are present today that greatly alter the roles that must be played by engineers who aspire to become leaders in their profession.

The first and most important of these features is that our country is in a deadly serious space-technology competition with an able and determined competitor who has very great resources in brains, man power, and money. The reward for maintaining a good position relative to Russia in this "trial by science" is peace, however uneasy it may become. The penalty for allowing our achievements to lag behind could very well be catastrophic defeat.

The second feature of the Space Age environment is that the magnitude of the job involved in developing an operational weapon system, such as the Air Force Atlas, is so great that only the government has command of enough funds to provide the needed financial support.

The third feature also exists because of the size of the task of realizing any Space Age transportation system. No one industrial or governmental organization has within itself all of the capabilities required. This means that collaboration among many great organizations, that in the past have usually been competitors, is necessary now.

The fourth feature of the Space Age environment is that, to be effective, new and complex developments, often involving research and invention, must be kept on co-ordinated schedules that are very tight compared to the periods allotted in the past for similar projects. These stringent schedules place heavy burdens of responsibility on scientists and engineers who must make rapid decisions on the basis of information that is often very scanty.

Because complete vehicles are so expensive and difficult to manufacture, the testing of any considerable number of units is out of the question. This state of affairs places a great premium on the use of data collecting and processing equipment by highly capable engineers. The interpretation of experimental results, when they are available and verified, also has become one of the most important aspects of engineering.

Space Age developments, moreover, involve the manufacture of relatively few highly complex items rather than tens of thousands of such comparatively simple devices as the aircraft of the past. This introduces severe problems of finding work for considerable numbers of people. Companies that have done well in the aircraft field find themselves compelled to fight for places in Space Age developments in order to maintain their usual levels of employment. Not all companies can expect the same volume of business that they have received in the past. The financial power of our government, vast though it is, is still limited.

As a result of the severe competition among companies, some of which foresee problems of survival, a considerable proportion of our ablest engineers now are engaged in preparing and presenting space-technology proposals to government agencies. This work can no longer be done by sales departments; it requires the best efforts of top-level engineering people.

These efforts are required almost continuously because the Space Age game of move and countermove with Russia keeps technical requirements from reaching any state of reasonable stability. The changes involved are so great and occur so rapidly that a system is usually obsolete before it comes anywhere near the operational stage. Superb judgment, extreme effort, and good fortune are required on the part of an engineering department that keeps its company in a healthy condition when support depends on Space Age projects. The forced-draft pace that results very

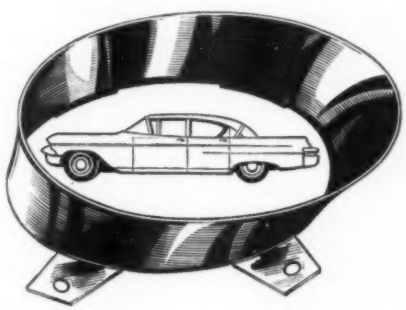
(Continued on page 306)

BUSINESS IN MOTION

To our Colleagues in American Business . . .

Recently, a manufacturer of top-flight motor cars was having trouble in producing the escutcheon for the front bumper lamps used on his newest model.

First of all, the breakage of the part was excessively high. Secondly, the escutcheon which is drawn at an angle, and contains a concave surface on the inside presented a problem in that, after buffing, polishing and flash plating, the finish produced did not exactly match the chrome-plated bumper.



Having worked with this manufacturer in helping him successfully solve other metal-working problems, Revere's Technical Advisory Service was called on for consultation.

The possibility of using Revere 70-30 Brass Strip was discussed and after a cost analysis, showed its complete feasibility. Samples were made up for testing on production-line stamping presses. A trial run was made and much to the encouragement of all concerned, there was not one "breaker" in the lot. Switching to this more ductile metal not only resulted in less wear on tools, but it was found that little adjustment of the presses was necessary from that of the setting used on the previous material. Breakage was reduced to less than 1%.

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And, because practically every industry you can name is able to cite similar instances, we suggest that no matter what your suppliers ship you, it would be a good idea to take them into your confidence and see if you cannot make a better product at lower cost by specifying exactly the right materials.

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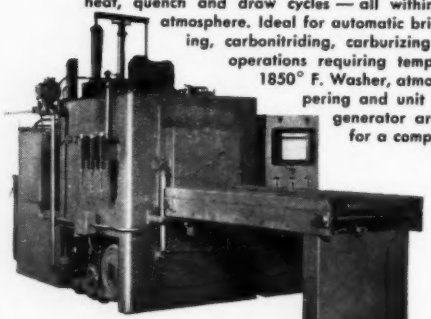

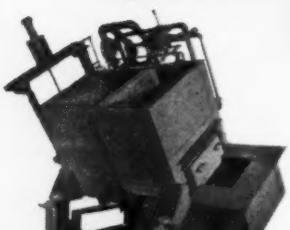

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TALK OF OUR TIMES

(Continued from page 304)

often requires that inventions be made almost on schedule.

Engineers, in general, must accept responsibilities that are far wider in scope than those that they have shouldered in the past.

"Know What" Must Be Added to "Know How"

John B. Wilbur, '26, Head of the Department of Civil and Sanitary Engineering at M.I.T., called attention to a difference between science and engineering when he spoke at the 25th anniversary celebration of the College of Engineering at Wayne State University. Why are engineers so often called scientists? Is art being crowded out by science? Professor Wilbur said in part:

■ We need to ask ourselves once again just what engineering is, and particularly how it differs from science. Somehow, people have become a little confused about this. Today, for example, the press hails Wernher von Braun as a top "missile scientist" rather than as the excellent engineer that he is.

There can be little doubt but that the border line between engineering and science has become a little cloudy in recent years. "Crash" research programs, in which military necessity frequently dictated that economics be tossed largely to the winds, contributed to this situation. In fact, there seems to have developed, in certain quarters, a feeling that scientists, and especially physicists, have now proven themselves to be better engineers than are engineers, themselves: wherefrom has sprung the gospel that it is better that engineers aspire to be pseudo scientists than it is that they strive to be first-rate engineers?

Now we certainly need scientists and engineering scientists, and we need them badly. We need more research on missiles, and more on nuclear energy, and we need more study into the whole gamut of things that will underlie the conquest of space. The point, however, that I wish to stress is that while we need scientists and engineering scientists, we have just as great a need for engineers; and we also need engineering humanists – and, indeed, just plain humanists. The

(Continued on page 308)

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TECHNICAL TALK often continues after class. The free and easy informality of the new Western Electric training program offers plenty of opportunity for the stimulating exchange of ideas.

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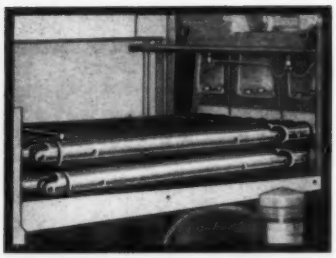
How Curtis solved a close center-to-center problem



The close center-to-center spacing of these drive spindles on a Sutton-Maust Precision Backed-up Roller Leveler created a tough problem for its manufacturer. He needed a universal joint strong enough to stand up under heavy rolling mill conditions, yet small enough to operate at such close quarters.

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TALK OF OUR TIMES

(Continued from page 306)

conquest of outer space may be the most sensational prospect of the moment, but the fact remains that most of tomorrow's engineering will still be done right here on earth. And being largely earthbound, it is a safe bet that most of our engineering tomorrow, even as today, will continue to revolve around people – and when I say people, I mean earthlings – and not little green people with great big ears.

Let us not forget that there are two related, yet somehow divergent aspects of technology: the first, which is dramatically apparent to everyone, is today's rapid pace of scientific and technological advance; the second, which if more subtle is nonetheless vital, is the extent to which civilization is able or, perhaps more correctly, unable, to keep pace with the impact of scientific and technological development. The gap between these two aspects is appreciable; the lag in the ability of society to assimilate technological advance into its culture appears to constitute one of the major problems of our times and of the foreseeable future.

This Twentieth Century is a time when it will be determined whether the products of technology are to be meaningful used or frightfully abused. Man-made perils have become ascendant over the perils of nature; and man seems an unreliable custodian of the power to destroy. Technology, in crossing the boundary of insured control, has swept us into an era of new dimensions. In a world polarized around science, we, as educators, will be derelict to our duty if we are content with the mere dispensing of knowledge without simultaneously doing our utmost to nurture the wisdom to contain it.

It seems appropriate, therefore, to suggest that while technical "know-how" is indispensable to engineering, human "know-what" may well be its more challenging and elusive aspect. One has only to think in terms of some of the great areas of civil engineering – such as transportation, water resources, housing, and public health – to appreciate the probable validity of this viewpoint. I take the stand that engineering, in its broadest sense, revolves around an understanding of man's condition, and an aim to better it; and that the significance of technological advance arises from the fact that it provides a means which – if properly used – can help to make this betterment possible.

The engineer must, of a certainty, have a firm grounding in science; but in professional practice, such knowledge is but a springboard for most of the situations he will encounter. He must operate in areas that are in part above and beyond the well-documented but relatively limited areas of systematized knowledge. Perhaps the principal function of the truly professional engineer is to harmonize and relate the conflicting forces and tendencies that – unlike the situations encountered in pure science – are bound to be present when one attempts to apply science to the welfare of society. Such a process of harmonizing and relating is not a science, but is an art in the highest sense; and if

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YOUR ENGINEERING CAREER
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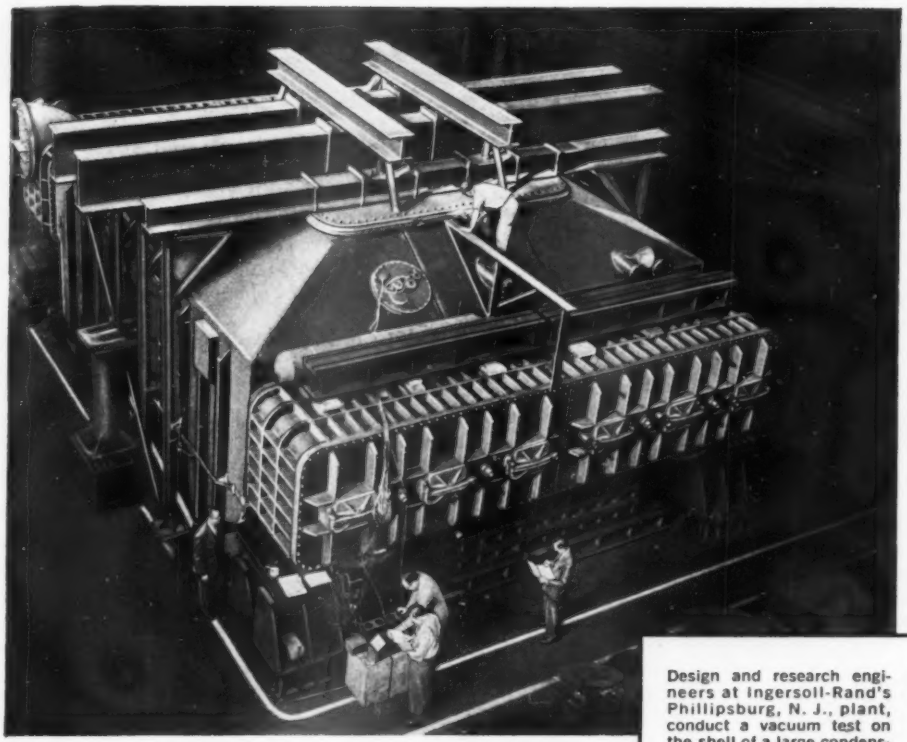

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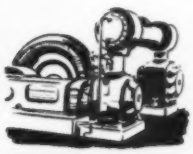

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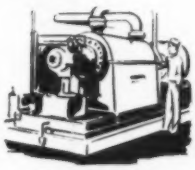

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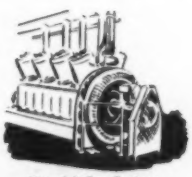

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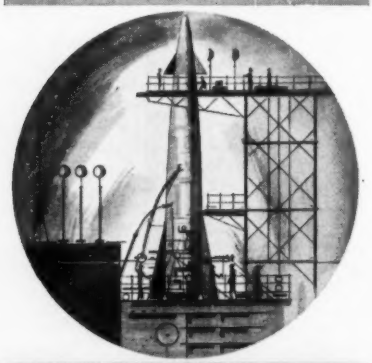

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TALK OF OUR TIMES

(Continued from page 308)

this art is crowded out by science to the point where we are merely training scientific technicians, then the very essence of professionalism in engineering will likewise be lost into the bargain.

Should You Help Boys Fire Rockets?

George P. Sutton, Hunsaker Professor of Aeronautical Engineering at M.I.T., described the dangers of basement rocketeering in an address last fall at the American Rocket Society's annual meeting. Here are excerpts from his remarks about playing with rockets:

■ There are today some two to three thousand local clubs or organized groups of boys who are virtually concerned with rockets. What should we tell them? Should we encourage them to build and fire actual rockets with propellants which are hotter than the melting point of steel and with fuels which can detonate and explode?

I, for one, want to discourage our young people from experimenting with dangerous chemicals, unless the proper safety measures, legal steps, training, experimental techniques, precautions, and qualified supervision can be used.

I know, personally, of nine experienced men in the rocket business who have been killed in explosions or fires of rocket propellants. They were not careless, and they knew all the tricks and safety precautions of the trade. Rocket fuels can be potentially several times more energetic than TNT or some of today's best gunpowders. A very small change in composition or formulation can turn a smoothly burning propellant into a vicious explosive.

While it is pretty well accepted that rockets sometimes blow up during ignition or the initial launching operation, it is not too well known that the actual *loading* of the rockets with propellants is perhaps the most *dangerous operation* of all. This is particularly true with solid-propellant rockets, some mono-propellants, and all types of igniters. During the launching you expect a mishap, and you generally take suitable precautions, but in the loading you have to have your hand right where you have the potential explosion.

A few of the amateur rocket organizations, particularly those associated with technical universities, have

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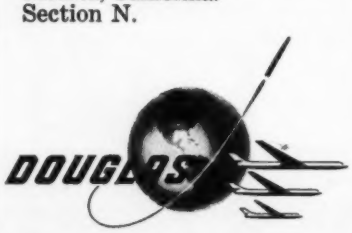

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TALK OF OUR TIMES

(Concluded from page 310)

constructed good facilities, instituted relatively good operating and safety procedures, and are working with local or state officials. They appear to have a good appreciation of the hazards and a noteworthy safety record. It can be done properly.

But what will you learn if you do fire or launch a rocket? It is usually a very short test, it lasts only a few seconds, and it is rather hard to see and catch with a camera. Are the many months of preparation worth the effort for that short few seconds of thrill?

There are many projects which are educational and beneficial, yet not hazardous. I have steadily encouraged my young friends to do these things.

To study and to learn new facts in science is one of the best ways to turn the interest from the dangerous, hazardous experimentation to a useful channel. To study mathematics, chemistry, meteorology, or any other facet of science which is connected with space flight is indeed a worthy and rewarding undertaking. This can be done individually or in groups.

A second suggestion is actually to build something. One group of youngsters studied and built a four-stage moon rocket missile model in which the proportions of the various stages and components were truly to scale. The wooden model was 10 feet high and was entered in a science competition. Other groups have built missile components in simplified form and made them work.

One can take these projects and studies and put them into forms or reports, slides, records, pictures, albums or posters, and enter them in fairs, expositions, school exhibits, or youth contests.

The young people who have a flair and a knack for technical studies ought to be helped and oriented toward scientific studies rather than be permitted to undertake dangerous and unnecessarily risky projects. This country can use all the top-notch scientific and technical talent that it can produce, and we do not need basement rocketeers or thrill-seeking rocket amateurs.

Choral Society Recording Now Available

A recording of the M.I.T. Choral Society's performance of Haydn's Theresa Mass in Munich, Germany, last summer is available now. The occasion was the celebration of Munich's 800th anniversary, and the concert was given in the recently rebuilt Herkules Saal of the Munich "Residenz."

Klaus Liepmann, Professor of Music at M.I.T., conducted, and the soloists were: Catherine Rowe, soprano; Margaret Tobias, alto; Donald Sullivan, tenor; and Paul Matthen, bass. The orchestra was the Graunke Symphony Orchestra. The issuance of this recording is particularly appropriate this year because this is the 150th anniversary of Haydn's death.

The 33 1/3-rpm, long-playing recording may be purchased for $3.95, plus 20 cents for mailing, from the Office of the Director of Music, Room 14N-236, M.I.T., Cambridge 39, Mass.

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10. Refinery for Standard-Vacuum Oil Company at Bombay, India
11. Refinery for Standard Oil Company (Indiana) at Mandan, North Dakota
12. Refinery for Suntide Refining Company at Corpus Christi, Texas
13. Refinery for Commonwealth Refining Company at Ponce, Puerto Rico
14. Refinery for Esso Standard Oil Company at Antwerp, Belgium
15. Refinery for Caltex at Visakhapatnam, India
16. Refinery for Neste Oy at Turku, Finland
17. Refinery for Irish Refining Co., Ltd., Cork, Ireland
18. Refinery for Esso Standard Française, Bordeaux, France
19. Refinery for Purfina Mineraloelraffineria A.G., Duisburg, Germany
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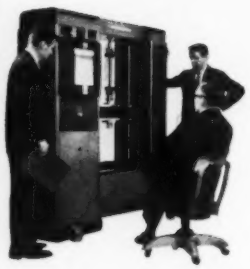

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UNIVERSITIES IN TRANSITION

(Concluded from page 295)

ing; and there should be secondary growing facilities scattered through the laboratories of a Center for auxiliary purposes. Similarly, there will be laboratories for structure analysis, for spectroscopy, chemistry, magnetic resonance, and so on, as strongholds of specialists, and simultaneously x-ray and chemical facilities, spectrographs, resonance equipment, and so on, strewn as auxiliary tools throughout the federation. Each individual laboratory should own those facilities that are required full time in its program. The strength of the Center comes to the fore in the expert advice obtainable from specialized laboratories on the most effective use of such equipment. In this sense, theoretical physics and mathematics are also tools; we will expect to find theoretical physicists and mathematicians in many laboratories, strongly backed by a theoretical group of the Center.

Thus an association of laboratories emerges, different for each university depending on prehistory, existing facilities, and the driving research spirit of its faculty. Such a Center can adjust itself flexibly to the needs of the times: old laboratories will die out, new ones take their place; scientists and engineers may remain in one laboratory or enjoy varying alliances as their research projects demand; some members will become actively interested in all "Center" problems and act as catalysts correlating and consolidating information by intelligent discussion; and common facilities will be created as the need arises.

Initially, only a few laboratories in any one university may be really ready for this kind of adventure and willing to share the burden in time and effort required for its realization. Natural allies are, for instance, fundamental theoretical and experimental research projects concerned with the electric, magnetic, mechanical, and thermal properties of matter, with structure analysis, spectroscopy including magnetic resonance, structure chemistry, polymer science and crystal growth. As confederates from the molecular engineering side they might find projects concerned with the development of computers and transistors, energy converters and memory devices, high-temperature materials for space vehicles and new propellants for the atomic age. Obviously, many more subjects could be mentioned, and any "Center for Modern Materials Research" must remain in spirit an "open club" prepared to admit new members.

It must be understood that this "modern materials research" operating on the molecular plane does not look condescendingly down on older approaches. On the contrary, the classical knowledge about materials and materials testing remains indispensable for our industrial civilization and should be represented in the "Center" as a true partner. Only by knowing both aspects can we arrive at a full understanding and give to empirical data and test methods a deeper meaning.

Blood Donations Increase

Despite storms which made appointments difficult to keep, M.I.T. students contributed more blood in this year's drive than was given last year. The Technology Community Association conducted the blood drive.

3-D Radar..Tells... Distance, Altitude
(Pictures on Page 3)
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three dimensions: height, bearing and distance. On the left is th
housing the antenna which obtains the information and trans
radar van on its right. Other trailers contain diesel generators wh
system in the field. One generator is on a stand

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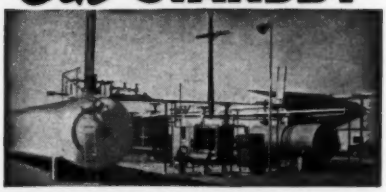

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TREND OF AFFAIRS

(Continued from page 292)

■ Special awards and honors have been announced recently for the nine Alumni enumerated below:

To *Harry A. Wansker, '17,* citation for "outstanding service to the U. S. Army Chemical Corps," by the Department of the Army . . . to *Donald W. Kitchin, '19,* and *Orison S. Pratt, '41,* first prize in the science and electronics division for a paper entitled "Treeing in Polyethylene as a Prelude to Breakdown," by the American Institute of Electrical Engineers;

To *Walter J. Hamburger, '21,* the Harold DeWitt Smith Memorial Medal, by the American Society of Testing Materials . . . to *John W. Beretta, '23,* the Engineer of the Year award, by the Bexar Chapter, Texas Society of Professional Engineers . . . to *James C. Evans, '25,* a Career Service Award as one of the 10 top career men in the federal government for 1959, by the National Civil Service League;

To *Joseph F. Libsch, '40,* the Stoughton Award, by the Lehigh Valley Chapter, American Society for Metals . . . to *William C. Brown, '41,* the grade of Fellow, by the Institute of Radio Engineers . . . to *Thomas T. Jones, '54,* the Army Commendation Ribbon with Metal Pendant, by the United States Army.

(Continued on page 318)

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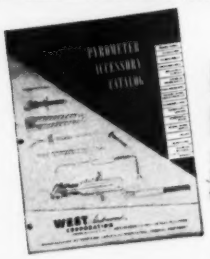

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Recently, he presented to Mr. Cerf his proposal for a revised Profit Sharing Plan for the staff of Random House. They went over the details together and developed a program which will benefit employees in every salary bracket — providing more life insurance protection for less money than was previously possible.

Henry will, of course, work closely with company officials in servicing this plan through the years. And he'll continue the personal programming for a number of the executives at Random House. This one report of Henry's activity is just a part of the outstanding job he's been doing for New England Life, ever since he joined us in 1952.

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New Books from the Technology Press

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Edited by Louis D. Smullin and Hermann A. Haus

A discussion stressing the mathematical theory and basic physical phenomena of noise in electron devices. The book is based on a special summer session on noise in electron devices held at M.I.T. in 1955, and is a comparison of the various treatments of noise. Problems of noise due to thermionic emission, the general circuit aspect of noise in microwave tubes, and some of the detailed engineering solutions to the problems encountered in the design of low-noise traveling-wave tubes and space-charge control tubes are considered by specialists drawn from both industrial and academic fields. $12.00

The Physical Chemistry of Steelmaking

Edited by John F. Elliott

A symposium based on the papers presented at the conference on the physical chemistry of iron and steelmaking, sponsored by the Metallurgy Department in 1956. Both the conference and the book were designed to present the latest research in this field in an effort to stimulate a greater understanding of the research data applicable to steelmaking systems. $15.00

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TREND OF AFFAIRS

(Continued from page 316)

New Scientist for Advanced Projects

■ Next month, George P. Sutton, who is Jerome Clark Hunsaker Professor at Aeronautical Engineering at M.I.T., will become chief scientist of the Defense Department's Advanced Research Projects Agency. He will succeed Herbert F. York, who is to become the department's director of Defense Research and Engineering.

Professor Sutton is a former president of the American Rocket Society. He came to the Institute last fall from the Rocketdyne Division of North American Aviation, Inc.

The Hunsaker professorship which he has held this year was conceived by the late Major Lester D. Gardner, '98, founder of the Institute of the Aeronautical Sciences, and established in 1954. To emphasize the national character of this endowed chair, the late Glenn D. Martin contributed a special gift for presentation of an annual lecture named in honor of his mother, Minta Martin.

Professor Sutton delivered the fourth Minta Martin lecture at M.I.T. last month on "Rocket Propulsion Systems for Space Flight." The Institute of the Aeronautical Sciences and the California Institute of Technology have arranged for him to repeat this lecture in Los Angeles on May 12.

Penicillin Production Progress

■ Recent penicillin news has been confusing but good. First, reports of the work of a group of British chemists led some folk to think that they had synthesized penicillin. Then, the American Chemical Society announced that it was bestowing a $1,000 award on John C. Sheehan, Professor of Organic Chemistry at M.I.T., for work that included the synthesis of penicillin. What were the facts?

Ever since penicillin's great value in medicine was discovered, it has been made from molds, in which it grows in a natural process of fermentation. The British chemists recently succeeded in stopping the fermentation when a basic ring structure had been formed and adding a side chain. By this process they isolated a compound known as 6-aminopenicillanic acid.

Dr. Sheehan had produced this compound, too, but had done it differently. He had reported preparation of this compound via a synthetic route and conversion of it into a variety of penicillins. His methods were chemical and did not involve the fermentation process.

New forms of penicillin and new processes for producing it are being sought for two reasons: New forms may be useful against bacteria that are now resistant to penicillin and diseases that cannot now be treated successfully with it, and new forms may be tolerated better by patients who are now allergic to penicillin.

"The British group, like our own team, are now engaged in a research program to discover which, if any, of the chemically modified penicillins will have

medical advantage," Dr. Sheehan said, when asked about the confusing newspaper items. "In other words, both groups are now trying to find what particular member of the penicillin family looks most promising and extensive tests will be required before any of the new drugs will be released for medical use. The British workers have described an interesting variant of the present commercial method of fermentation.

"Here in our M.I.T. laboratory we had previously reported the synthesis of a biologically active synthetic penicillin which differed from the natural penicillins only in the side chain, and two years ago, using this general method, Merck, Sharp and Dohme Research Laboratories in Rahway, N. J., prepared more than 10 synthetic penicillins which were all biologically active.

"The British development offers an alternative way to prepare some of these penicillins.

"There are now three approaches to the preparation of new penicillins. First, our totally synthetic route which is capable of greater variations and can even alter the penicillin ring structure as well as the side chain, but which appears to be the most expensive of the three routes. Our second approach is by removal of the side chain from a natural penicillin and replacement with a different side chain. The third method, reported by the British, is to interrupt the fermentation at the aminopenicillanic acid stage and add the side chain in a one-step chemical process. On the basis of the present information, it is not possible to decide which of the latter two approaches would be commercially advantageous for the production of a new penicillin."

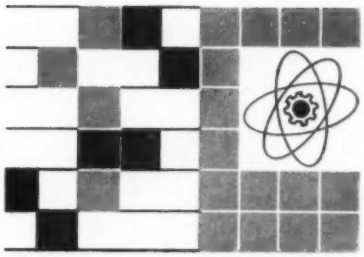
John Edmonston of the Merck, Sharp and Dohme Research Laboratories added to Dr. Sheehan's explanation of the situation: "Our investigation in this field continues and we have hopes that a practical product may be developed in the future. Several of the new penicillins are effective against certain strains of staphlococci resistant to Penicillin G. They proved active in animals. However, the effectiveness has not been on an order of magnitude to be practical for a product to date."

In addition to synthesizing penicillin, Dr. Sheehan has developed a selective method for synthesizing peptides, using carbodiimide as a key reagent. Peptides vary widely in nature. Some important hormones and antibiotics, for example, are peptides. Dr. Sheehan planned to report to fellow chemists on this work when he accepted the prize this month for "creative work in synthetic organic chemistry."

Lessons from Flying's History

■ Grover Loening, who was Orville Wright's first aeronautical engineer, will inaugurate the Lester D. Gardner Lectures in the history of aeronautics at M.I.T. on April 10. "From the earliest days of the first primitive flying machine, aircraft development has suffered because new ideas have gone unappreciated and important new developments have remained unused," Mr. Loening says, in speaking of his topic. "Lessons from mistakes in design can be as useful as those from successful experiments; both are vital today."

(Continued on page 320)



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TREND OF AFFAIRS

(*Continued from page 319*)

10 Years of Industrial Liaison

■ For 10 years now, M.I.T. has had an Industrial Liaison Program. Companies participating in it regularly send scientists, engineers, and executives to the Institute to be briefed by the Faculty on such diverse subjects as x-ray and neutron diffraction techniques in metallurgy, research and development in decentralized companies, reinforced plastics, biophysics, and conversion of heat to electricity.

This organized program of communication with industry now includes 88 of America's leading industrial concerns, and has been used as a model for similar programs at other schools. Each participating company supports the Institute through large, unrestricted grants, which help pay current operating expenses.

"The problem of keeping pace with rapidly changing technology is one of the most persistent and challenging tasks facing industry today," says Vincent A. Fulmer, '53, Director of the liaison program. "At M.I.T. we take pride in having found a means by which a company can keep its ear to the ground and at the same time benefit the Institute immensely by providing professional stimulation and badly needed financial support. This year, M.I.T. will realize $1,250,000 from this collaborative arrangement, an amount roughly equivalent to the tuition payment of 15 per cent of the student body.

"One thing seems clear from 10 years of experience with this type of liaison: Its full potential for service to industry and to M.I.T. has not yet been realized."

WTBS Seeks Wider Horizons

■ Since 1946, M.I.T. undergraduates have had their own radio station, supplying music and news to the dormitories. About 100 students participate now in its management, maintenance, and programs. N. Addison Ball, '60, is the station's manager, and Linda H. Greiner, '60 is the assistant manager.

A first step toward making this station audible throughout Cambridge and Boston is being taken this spring. A corporation to be known as the WTBS Foundation is being organized to seek an FM channel for WTBS. Houlder Hudgins, Professor of Industrial Management, will be chairman of the new corporation's executive committee, and D. Reid Weedon, Jr., '41, will be its treasurer.

(*Continued on page 322*)

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TREND OF AFFAIRS

(*Continued from page 320*)

The High Cost of Breathing

■ The Alumni Council, at its February meeting in the M.I.T. Faculty Club, heard about two kinds of atmospheric changes: John T. Rule, '21, Dean of Students, contrasted the life of his classmates when they were undergraduates with that of the Institute's students today; and Rolf Eliassen, '32, Professor of Sanitary Engineering, described the causes, effects, and costs of controlling air pollution.

Dean Rule reported changes for the better. The atmosphere of undergraduate life has been improved by additions to the Institute's facilities. More students live in dormitories nowadays. Special events in the Kresge Auditorium, services in the M.I.T. Chapel, and intramural sports keep students on the campus more of the time, and their presence is a challenge to the Faculty and the Administration to create the most favorable environment possible. "We are developing a house master system," Dean Rule continued. "We want students to have a richer life on campus. We want them to feel that their imaginations are being stretched. We are putting into the dormitories an atmosphere of maturity and intellectual excitement."

Professor Eliassen reported changes for the worse. The 15,000 quarts of air per day that each of us requires is becoming more polluted, in more diverse ways, by the gases and liquid and solid particles that are discharged into the atmosphere by industrial plants, cities, homes, and cars. Contaminated air is injuring both people and property, despite the tens and hundreds of millions of dollars that have been spent to install and operate incinerators, scrubbers, precipitators, and other devices. Lung cancer is more frequent in cities than in rural areas. Corrosion, agricultural losses, and poor visibility at airports have also been traced to pollution in the air. More work must be done in several scientific disciplines to reduce it, and the cost will be high.

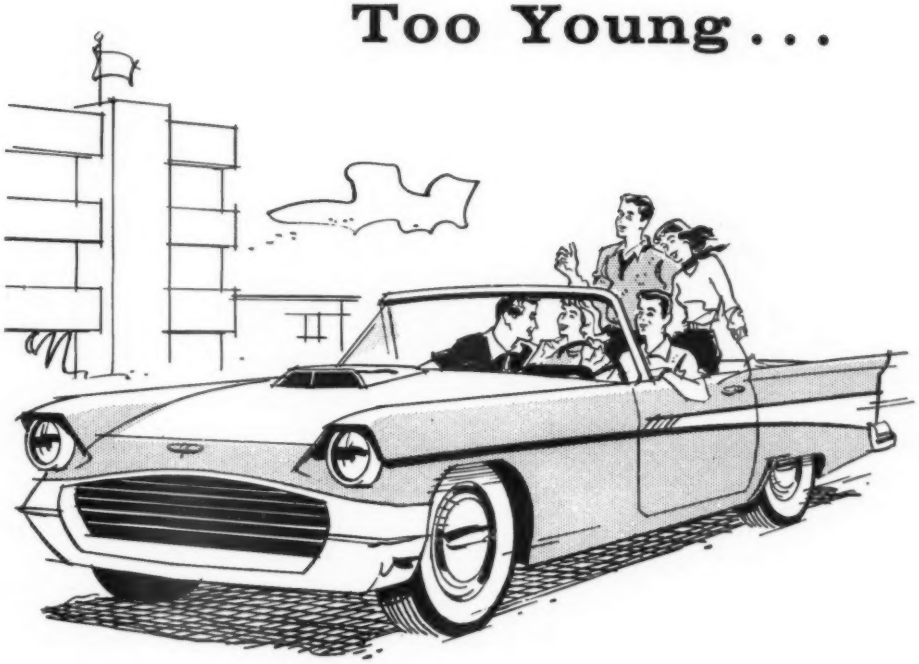
"We know the causes in many instances," Professor Eliassen concluded. "We know some of the consequences. Controls can be brought about, but can we afford them? Money, people, and the desire are needed to clean the air."

Alf K. Berle, '27, reported that 9,414 Alumni had contributed $380,300 to the Alumni Fund on or before February 13 and that these figures were, respectively, 8.5 per cent and 35 per cent higher than last year's totals for the same date. He urged the 7 per cent of the Alumni Council's members who had not yet contributed to do so before the next meeting.

John A. Lunn, '17, reported on the work of the National Nominating Committee, of which he is chairman. John J. Wilson, '29, President of the Alumni Association, presided at the February meeting, and Donald P. Severance, '38, read the Secretary's report. It recorded two changes in class affiliation and 15 visits to local clubs and one regional conference.

(*Concluded on page 324*)

Too Much . . .
Too Young . . .



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TREND OF AFFAIRS

(*Continued from page 322*)

The Seven Foreign Fellows' Fields

■ The first seven Sloan Foreign Postdoctorate Fellows are working this year in the M.I.T. School for Advanced Study. Their previous research had attracted the attention of members of the Institute's Faculty. While here, they have no teaching obligations, and their studies are varied:

Jan W. Kuiper, a bio-physicist from Holland, experiments with the lateral line organ of fish to find the similarity between this primitive sense organ's responses and those of the human ear.

Alan N. Stroh, a British physicist born in South Africa, studies such metals as iron, aluminum, and zinc to determine how dislocations interact to produce cracks.

Mihajlo Mesarovic, an electrical engineer from Yugoslavia, employs statistical analysis to discover the dynamic responses of large complex systems.

Kenzo Sugimoto, a nuclear physicist from Japan, studies nuclear excited states with the Rockefeller electrostatic generator team.

R. Challis Brown, a chemist from Australia, is doing research involving the alkaloid Aconitine, a complex, poisonous drug which has defied analysis.

Azriel Levy, a mathematician from Israel, is comparing ways of presenting the axiomatic set theory.

Ronald J. Gribben, a British mathematician, is concerned with fluid dynamics, and particularly with boundary layers in conducting fluids in the presence of a magnetic field.

The average age of the group is about 29. The fellowships they hold were provided by the Alfred P. Sloan Foundation and conceived on the theory that foreign scientists could contribute much to the American scene and the belief that progress is best nourished by a continuous exchange of ideas.

The Institute Wins for Iraq

■ The seven M.I.T. students who participated in a recent mock United Nations Assembly meeting in Montreal represented Iraq. They would have preferred to represent Israel. Nevertheless, they won the "Best Delegation" trophy.

The criteria for the award were the delegates' knowledge of the problems discussed, their presentation of a country's views, and their abilities in the lobby as well as on the Assembly floor. Sixty schools participated.

One of the resolutions that came up concerned the organization of a peace conference. Unfortunately, the Israeli delegation had to be ejected forcibly when it tried to sit in on an Arab nations' caucus.

Jaime H. de Sola, '60, headed the M.I.T. corps of diplomats, which included one Iraqui, Mumtaz Al Daftary, '61, and one girl, Linda H. Greiner, '60. Others were Gerard J. Stephenson, Jr., '59, George R. Henry, '59, Stephen P. Gill, '61, and Klaus H. Berkner, '61.

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PREVIOUS EMPLOYMENT: Public Accountant

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Note Ed Fein, like so many other college alumni, is well-established in a career as a New York Life representative. It offers him security, substantial income and the deep satisfaction of helping others. If you or someone you know would like more information about such a career with one of the world's leading life insurance companies, write:

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THE GREAT STAIRWAY FOR SHIPS OPENS

(Concluded from page 301)

25,000,000 tons will move through the new Seaway. By 1968, it is estimated that traffic will have increased to more than 50,000,000 tons, and cargoes moving through the Welland Canal alone will have increased from 40,000,000 to 60,000,000 tons.

Any increase in shipping in the new Seaway depends on many factors, including freight and toll rates, time of transit and, of course, the inertia inherent in changing from long-established patterns of shipping to entirely new methods. The Seaway will have strong competition from other forms of transportation and routes, and growth in trade will depend on how attractive freight and toll rates can be made. Tolls lower than those imposed on ships using the Panama and Suez canals have been announced.

Construction of the Seaway has fired the imaginations of people in the region through which it operates, and there has been much talk of the possibilities of enlarging the canal system which now links the Hudson River at Albany with the St. Lawrence via the Lake Champlain Canal and the Richelieu River Canal in Quebec. By this route the distance from New York City to the St. Lawrence River is 389 miles. The distance, by way of the Atlantic Ocean and up the St. Lawrence, is more than 1,500 miles.

American and Canadian communities bordering on the Seaway may expect dramatic industrial developments in manufacturing fields that can benefit from an ample power supply and convenient transportation for raw materials as well as for finished products.

The Aluminum Company of America already has a large plant at Massena, N.Y., where the Reynolds Metal Company and the General Motors Company also are building factories. Other companies on both sides of the border are making plans for industrial development of the region.

The Seaway will be formally dedicated in June, when Queen Elizabeth and President Eisenhower, Prime Minister John Diefenbaker and Governor General Massey of Canada, statesmen and diplomats, premiers and governors, the great and the near great, will join in an international ceremony celebrating completion of one of the world's great engineering projects.

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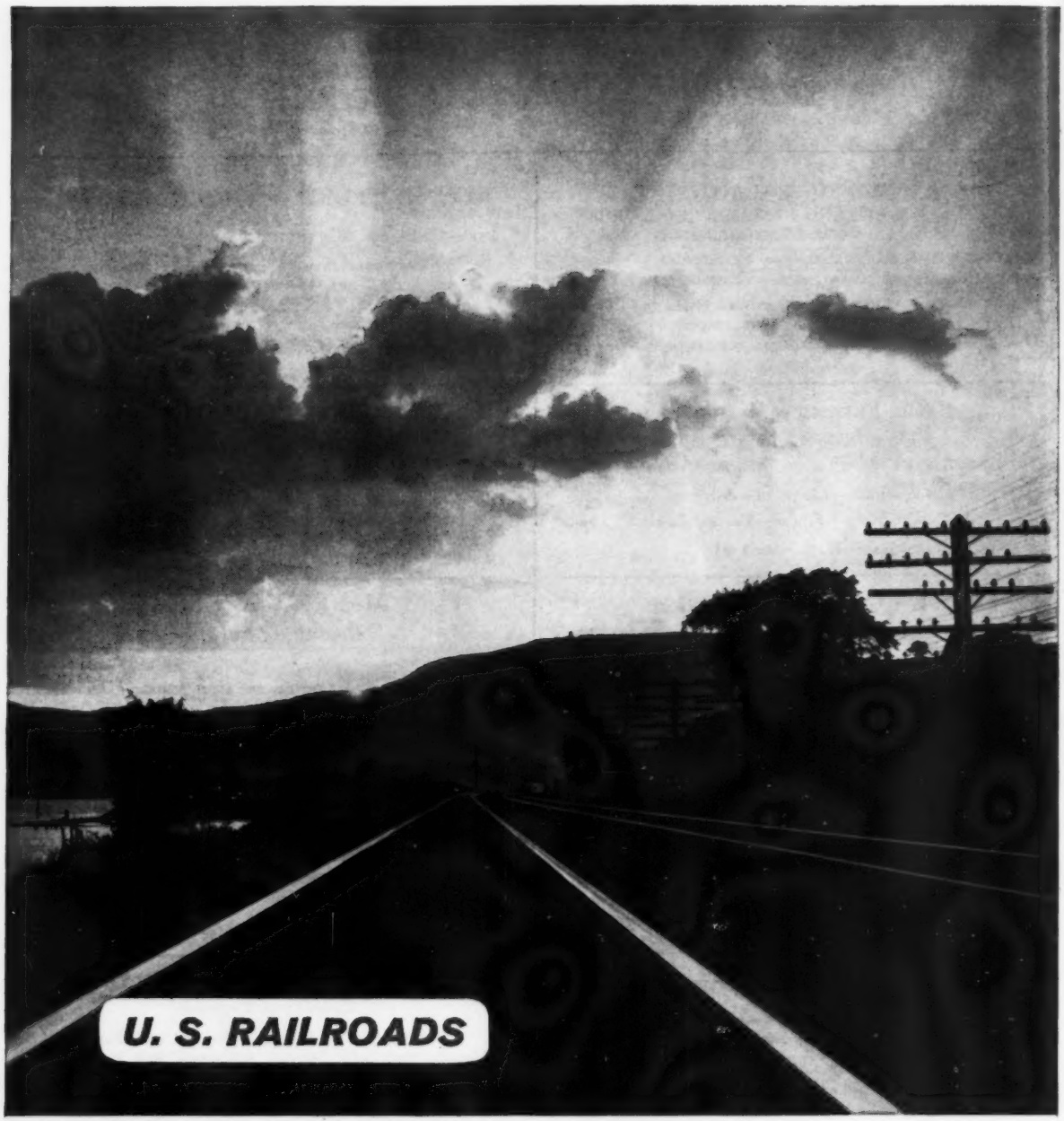

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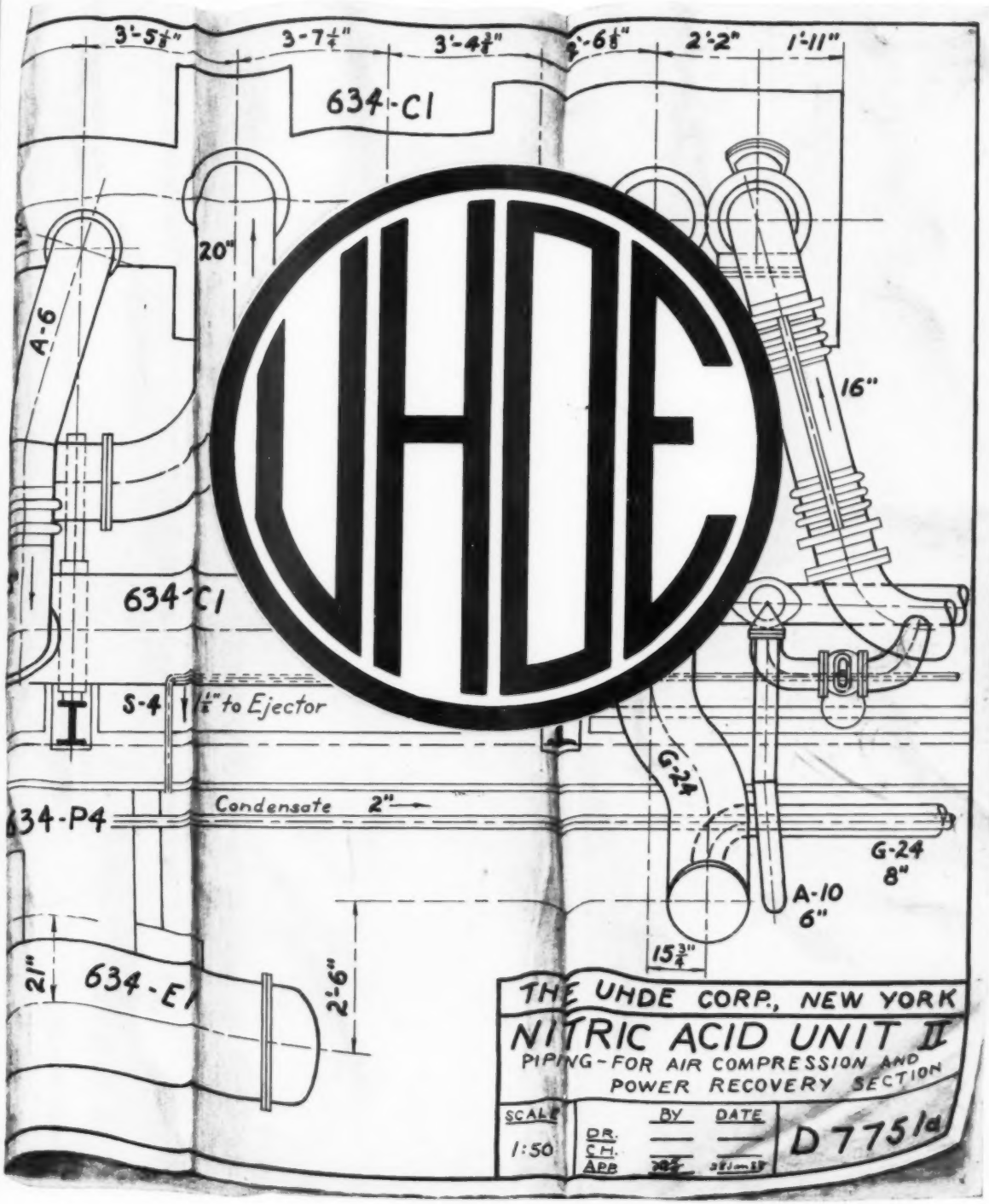

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